ENGINEERING NEWS.

Tribune Building, New York City.
GEO. H. FROST, PROPRIETOR.

SATURDAY, MAY 7, 1881.

WE wish to buy second-hand copies of Wellington's "Economic Theory of Location of Railways," for which we will pay two dollars per copy for all that are offered.

IN reply to numerous inquiries about the date of publication of Wellington's new edition of "Economic Theory of Location of Railroads," we beg leave to say that Mr. Wellington is in Mexico, and we have no information from him that will enable us to say anything authoritative on the subject. But we do not expect to see the book in print this year at least.

PERSONAL.

J. D. Moler has been re-elected City Engineer of Springfield, O.

Brush, the electric light man, has an income of $1,000 a day.

C. C. Lovejoy has been appointed to the position in the Hudson River tunnel recently resigned by J. F. Andersen

Mr. Wm. E. Hoyt, late of the New York, Chicago & St. Louis Survey, has been appointed Chief Engineer of the Rochester & Pittsburgh R. R.

Col. J. B. Yates has been appointed Chief Engineer of the North Carolina Midland R. R., which is organized to extend the Virginia Midland through North Carolina.

The address of the American Society of Civil Engineers is 127 East Twenty-third street, New York. The Society has removed from 104 East Twentieth street, to its newly purchased house at the above address.

Mr. Secretan, C. E., division engineer of the Canada Pacific Railway, left Winnipeg on the 22d inst. with a party of surveyors for Grand Valley, from which place they will proceed to locate the line westward toward the Rocky Mountains.

Prof. Richard A. Proctor, the astronomer, was married at St. Louis on the 3d inst., to Mrs. Sallie D. Crowley, of that city. The bride is the daughter of Charles M. Thompson, of this city, and a niece of General M. Jeff Thompson, of Confederate fame.

Mr. A. A. Allard, a young engineer of great promise, in charge of a locating party on the Yellowstone Division of the Northern Pacific Railroad, was accidentally shot and killed by the discharge of a revolver in the hands of one of his party last week.

The New York State geological survey has lasted over 40 years, cost over $1,000,000, and is not completed yet. There is a disposition on the part of Gov. Cornell to drop it, by vetoing the current annual appropriation for a salary to the State geologist, James Hall, appointed in 1835.

Col. Jas. H. Bowen, a well-known real estate dealer of Chicago and formerly one of its wealthiest, most active and honored merchants, was killed by being thrown from his carriage at a railway crossing at South Chicago on Saturday last.

On the 27th of April Mr. Robert H. Sayre, General Superintendent and Chief Engineer of the Lehigh Valley Railroad, was at Los Vegas, New Mexico, in company with a number of other Eastern railroad magnates, who were about to go to San Francisco, Cal.

J. T. McManus has resigned his position as Superintendent of the Western and Springfield divisions of the New York & New England Railroad, to take effect May 1. Mr McManus retires after a service of twenty-five years. His successor, J. C. Rawn, a professional civil engineer, has a railroad experience dating from 1867, when he was employed on the Northern Central railroad of Pennsylvania.

The Holly Manufacturing Co., of Lockport, N. Y., and the Siemens-Anderson Steel Co., have opened a joint office at No. 157 Broadway, this city, which will be in charge of Mr. C. G. Hildreth, the secretary of both companies. Messrs. Park Benjamin & Bro., who have been agents for the Holly Company for the past year, have resigned that position in order to become consulting engineers for the Holly Company, and experts in patents for the Siemens-Anderson Company.

A board of officers of the Corps of Engineers, to consist of Colonels Henry N. Benham and Z. B. Tower, Lieutenant-Colonel Henry L. Abbot and Major Cyrus B. Comstock, has been constituted to meet in New York City for the examination of the following named officers, with a view to their promotion in the Corps of Engineers when legally entitled thereto: Second Lieutenants Theodore A. Bingham, Curtis McD. Townsend and Gustav J. Fiebeger.

The following surveyors will be employed on Dominion land surveys during the coming season: J. L. P. O'Hanly, Wm. Ogilvie, J. A. Ryley, C. E. Wolff, A. F. Cotton, A. Clifford Thompson, and Mr. Vanbuskirk, Ottawa; J. C. Rainboth, Aylmer; Edgar Bray, Oakville; Thos. Kairns, Credit Valley Railroad, Toronto; Thomas Drummond, Montreal; Milner Hart, St. Mary's, Ont.; A. C. Webb, Brighton; M. F. Thompson, Cannington; Otto J. Klotz, Preston; J. C. Ling, Meaford; W. S. Gore, Peterboro'; C. F. Miles, Wingham; Thomas Fawcett, Uffington; W. S. Pearce, Winnipeg; J. L. Reid, Prince Albert, Northwest Territory.

Thos. W. Jaycox, who for a number of years was assistant engineer on the city improvements in Washington, D. C., resigned his position there to form the partnership of Jaycox, Goad & Corning, civil and mining engineers, in Leadville, Col., was elected City Engineer April 8, 1881, of that well-known mining center, which is now a city of upward of fifteen thousand inhabitants, rapidly increasing in size, and promising to remain second only to Denver in importance in the State. No doubt the friends of Mr Jaycox will learn with pleasure of the success he has met with in the Far West.

John Lee, a contractor widely known, died at his home in Easton, Pa., Thursday, evening the 28th ult., in his 67th year. He came from Ireland in 1838, settled in Reading, and in 1866 moved to Easton He held and filled contracts on roads and canals in Canada, the Erie road, Hudson River road, the Air Line in Connecticut, the Union Canal at Reading, the East Penn road, Morris & Essex road in New Jersey, the Canadaigua and Niagara Falls road and other roads. He did all the contract work of the South Mountain road that was done in New Jersey. He also contracted for the Northampton County Prison with John Biglin.

Mr. J. F. Andersen, Superintendent of the Hudson Tunnel Company, has resigned his position on that work to take entire charge of the substructure of the Atchafalaya Bridge on the line of the New Orleans and Pacific Railroad. Mr. Andersen has had a valuable experience in the sinking of piers for the Omaha Bridge, the South Street Bridge, Philadelphia, and in the Hudson Tunnel. Mr. Andersen has already gone to take soundings, etc., for the new bridge, and will return in about three weeks with the specifications, when the contracts for the iron work for the substructure will be let. The workingmen of the tunnel, when they learned that Mr. Andersen was about to leave them, presented him with a very handsome silver tea set, accompanied by a letter expressive of the highest commendation of his conduct toward them and of his ability, and of deep regret at his departure.

Those who take an interest in Brazilian railway progress will be pleased to know that Signor Antonia Ferrucci, the chief engineer of the great railray now in construction on the Parana, is a son of Michele and Caterina Ferrucci. Dom Pedro de Alcantara selected him in Florence, and took him with him to Brazil, where he has had abundant reason to be pleased with the genius and conscientious integrity of the man.

Commendatore Michele Ferrucci, of Pisa, the foremost classicist of all Italy, is now in his eighty-fifth year, and celebrated in November last the sixtieth anniversary of his call to the professor's chair. He is of a noble Florentine family, though born at Lugo Ravenna. He has filled the chair of classical literature in the best schools of Italy, in Bologna and Pisa, among others, as well as in Geneva, where Mme. Ferrucci was also invited to lecture in the University on Dante and Italian literature in general. Deservedly great as is the reputation of Michele Ferrucci as the most finished Latin scholar of Italy, the fame of his illustrious wife, Caterina Franceshi Ferrucci, is still greater. She is the author of some ten works in prose and poetry, besides an exquisite life of her only daughter, Rosa Ferrucci, which has become a classical book in France and Italy. This venerable lady is also an accomplished Greek and Latin scholar. But it is her mastery of her own native Tuscan, the exquisite melody of her verse, and the Attic purity of her prose that have won her the extraordinary distinction of becoming a member of the National Academy della Crusca—the only woman who has obtained such honor for 300 years.

THE NEW YORK AND BROOKLYN BRIDGE.

(*Continued from page* 172.)

THE BROOKLYN CAISSON.

The caisson was rectangular, being 168 ft. in length and 102 ft. in width. The height of the air chamber was 9 ft. 6 in., the thickness of the roof before launching was 5 ft. The sides formed a V, and were 9 ft. thick where they joined the roof and sloped down to a round edge. The inner slope of the V had an angle of 45 degrees, and the outer face of the caisson had a batter inward of 1 ft. in 10 to facilitate the descent. The cutting edge, or shoe, was formed by a semi-circular casting, protected by a sheet of boiler-plate extending 3 ft. up the sides. A heavy oak sill, 2 ft. square, rested directly on this casting; the three succeeding courses were of yellow pine and laid lengthwise. After that the alternate courses were heading courses. The entire V was firmly held together by drift and screw-bolts, and in addition there were heavy angle irons uniting the V to the roof, and at the principal corners the courses of timber were halved into each other and strapped together.

The immediate roof was composed of five courses of yellow pine sticks 12 in. square, laid close together, bolted horizontally and vertically, and having a set of bolts running through the whole of the five courses. After it was launched there were ten more courses added, with only the alternate timbers running in the same direction.

To make the caisson air-tight the seams were all thoroughly calked for a depth of four inches inside and out. In addition, a vast sheet of tin, unbroken throughout, extended over the whole caisson, between the fourth and fifth courses and down the four sides to the shoe. The tin on the outside was further protected by a sheathing of yellow pine. The space between the timbers was filled with hot

pitch and grout. As air under a pressure of from forty to fifty pounds to the square inch will penetrate wood with ease, the inside of the air-chamber was coated with a varnish made of rosin, menhaden oil and Spanish brown, which produced an air-tightness that was quite satisfactory.

The yellow pine timber used in construction came principally from Georgia and Florida. Its average weight was forty-eight pounds per cubic foot, although many sticks were so heavy as to sink in water.

SHAFTS.

The water shafts were two in number, rectangular in section, seven ft. by six ft. six in., and made of three-eighths-in. boiler-plate, properly stiffened by angle-irons and secured to the caisson timber. These shafts were open above and below, the lower edge extending twenty-one in. below the edge of the shoe. The material to be removed was shoved under the lower edge into the pool of water beneath, and then removed by dredges. (Plate No. 1 shows the general construction of the caisson, the manner of removing the material, and the first course of stone with the derrick for raising and placing in position.)

The air-shafts were two in number, three ft. six in. in diameter, and extended through the timber inside the well holes, the locks being placed on the top of the timber below the ultimate water level. At the bottom of the air-shaft was an additional door which hung down into the chamber and enabled the men to use the whole shaft as a lock. The two supply shafts, or pipes, were twenty-one in. in diameter, passed through the timber and extended two ft. into the chamber, and were carried up above water level. They were furnished with a door above and below and an equalizing pipe. When charged with material the compressed air was admitted when the lower door was opened and the contents fell into the chamber.

The air-chamber of the caisson was divided into six compartments by five dividing frames. These frames formed a heavy truss of pine posts and stringers, with side sheathing and side braces extending to the roof at every six feet, proportioned according to the strains which would be required in launching. The ends of the frames were secured to the sides by knees. The weight of the caisson was too great to be supported by only two ways, which would have been all that could have been used if the air-chamber had not been divided as described. By means of the five frames and two end edges, seven ways were supported under each caisson, and the average pressure per square foot of surface on the sliding ways was two and one-quarter tons.

The ground ways were made of two eleven-in. timbers, with the upper face of each chamfered, so that when bolted together they formed an obtuse angle at the center, with the apex one inch lower than the outer edges. The sliding ways were, of course, made to fit. Through the upper ends of the ground ways were passed heavy iron arbors, with squared ends, and a central cam. A long lever, with a squared socket, was so placed upon each of these squares as when tied down to cause the cams to project above the surface of the way. In the under side of the sliding way pieces of iron were set, with recesses left in front, into which the cams projected. At the time of launching, these cams held the caisson until the blocks were all removed; then at a given signal the ropes holding them were cut, and an absolutely uniform start assured. Strong struts were placed upon the sliding ways at their upper end, butting under timbers left projecting from the course next the top of the caisson. These served to give the caisson a cant forward as it arrived at the end of the ground ways, and insured its leaving them. The inclination of the ways averaged about seven-eighths of an inch per foot, increasing at the outer end in such a way as to give a curve with a radius of about eight thousand feet.

LAUNCHING.

In order to buoy up the forward end of the structure as it entered the water, and thus prevent its entire immersion, a temporary water tight compartment was put in one-third of the whole width. It served its purpose admirably. A full complement of wheelbarrows, crabs, winches and other tools were also placed within for future use. The total launching weight was three thousand tons, comprising one hundred and eleven thousand cubic feet of timber and two hundred and fifty tons of iron.

On the 19th March, 1870, the launch took place and was successful in every particular. The impetus the caisson acquired in the first part of its course proved sufficient to overcome the immense resistance offered by the water. The air caught inside of the air-chamber and assisted materially in buoying up the mass. The deck was not submerged, neither was the wave of translation in front very large.

A pump and boiler which had been set up on deck before the launch were put in operation, and in a few hours the water was all diplaced from the air-chamber, the air blowing out at one corner and thus proving a satisfactory state of tightness. Afterward, when the air was all allowed to escape, the top of the caisson settled to within seventeen inches of the surface of the water, which agreed with previous calculations.

PREPARING THE SITE OF THE FOUNDATION.

The preparation of the site consisted in establishing a rectangular basin, open toward the water side, the remaining three sides inclosed by a wall of sheet piling, and the bottom leveled to a uniform depth of eighteen feet below high water. This point was determined upon because one portion of the bottom was already that deep, and because the caisson required that much water to come in at all stages of the tide.

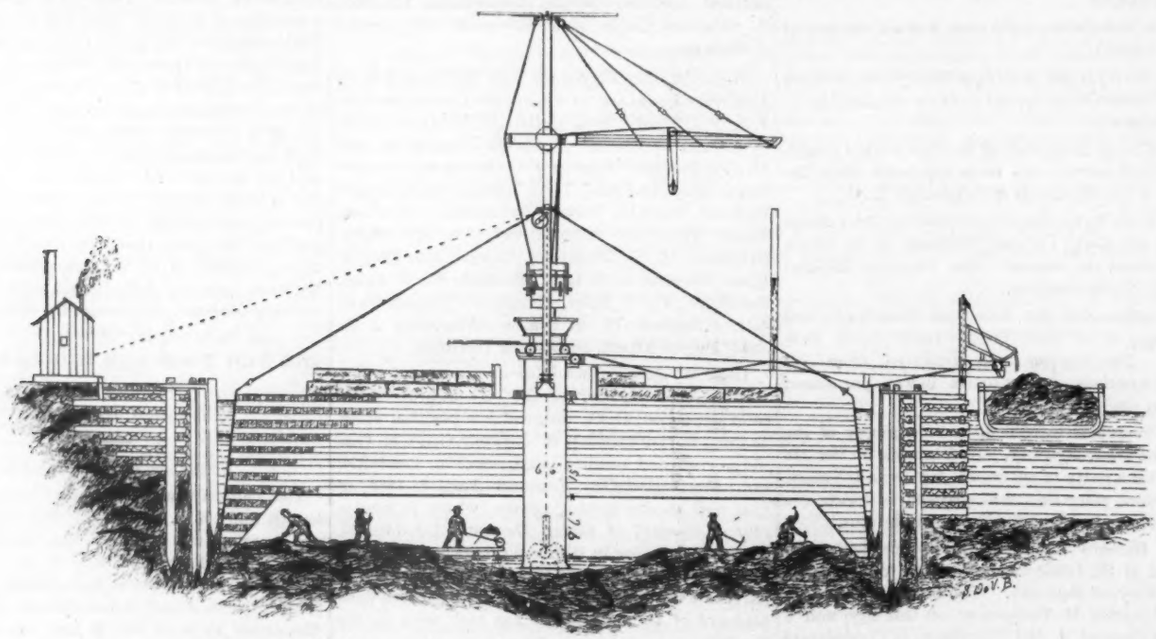


PLATE I.—BROOKLYN CAISSON—ARRANGEMENT OF EXCAVATING MACHINERY.

The dismantling of this place—the ferry slip—drawing one hundred piles, tearing out three hundred and fifty feet of fender sheathing, removing the same amount of heavy crib-work, filled with stone, and dredging of the loose material on top, required about one month's labor. The dredging was performed by the Osgood dredge, and the piles were drawn by a crane boat.

All the timber and piles taken out were found to be infested with thousands of sea-worms; their ravages, however, were confined to the space between low water and the mud line. A pile which was 16 in. in diameter below the mud line, and perfectly sound and free from worms, would be eaten away to a thin stem of three inches just above; all timber being affected alike. This experience showed the necessity of going below the river-bed with the timber foundation, and proved its entire safety in that position.

After about ten thousand yards of filling in and surface mud had been removed, a line of soundings was taken that showed the material to be nearly as hard as rock, and upon which the dredges could not make the slightest impression. Under these circumstances recourse was necessarily had to powder, and holes were made in the bottom of

four or five feet in depth and six inches in diameter by driving down an iron pile and then withdrawing it. Three such piles were used, twenty-two feet long, and shod with iron at point and head. Into these holes a cannister containing twenty pounds of powder was inserted by a driver, when the charge was exploded by electricity. This method loosened the materials sufficiently to make the dredges effective.

(TO BE CONTINUED.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 174.)

XIV.—NEWARK.

Newark, New Jersey, 9 miles from New York, on the west bank of the Passaic River, comprises an area of 17.91 square miles, 11¼ square miles of which are less than 50 ft. above the river. The remaining territory rises, by a moderate slope, to an elevation of about 225 ft.

About the year 1800 the Newark Aqueduct Company was incorporated to furnish water. The exact date at which the works were constructed is not known.

The source of supply was springs from the old red sandstone on the hill side, about 80 ft. above the river.

As the demand increased and the supply was found insufficient, additional springs were from time to time taken in, and wells sunk, in some places in a stratum of sand, and others into the rock.

All of these springs were affected more or less by the summer droughts, and some of them failed entirely.

The works were conducted by the Aqueduct Company until the year 1860, when they were purchased by the city of Newark for $150,000.

The company at this time was supplying about one million gallons per day, through 17.51 miles of pipes, none of which were more than 10 in. in diameter, and 11.6 miles were less than 4 in.

The springs did not yield more than 700,000 gallons per day, and the supply was eked out by using water from a brook which ran through the reservoir grounds, and also by occasional draughts from the Morris Canal, which passed near the reservoir.

The first improvement of the old works was the enlarging and deepening of some of the springs, in order, if possible, to increase their yield.

No considerable increase was obtained in that way. In 1862 a new reservoir, east of the canal, was built by cleaning out the old pond and raising and strengthening the banks.

In 1865 a second reservoir was built, adjoining the first, on the north. The capacity of these reservoirs is about twelve million gallons.

They were built in that location in order to render available the whole supply of spring water, and also to make use of such other sources as were then at hand.

New works were built in 1867, after the plans and under the direction of Geo. H. Bailey, C. E.

The supply is drawn from the Passaic River at Belleville near the northern line of the city.

The plan of the works contemplated the filtering of the water through the gravel and sand comprising the river banks. Two basins, each 140 ft. by 340 ft., were excavated through strata of alluvial soil, sand and gravel to a depth of 9 ft. below low water in the river, and near the shore.

The interior walls are vertical and of stone masonry laid in cement.

It was supposed that the water from the river would be filtered through the sand and gravel with sufficient rapidity to insure a plentiful supply.

At first, when the demand was small, the supply was ample. The quantity pumped was about 600,000 gallons per day in January, 1870, but as the demand increased the supply diminished, and in September, 1870, when about 2,000,000 gallons per day were needed, water had to be drawn from the river. In 1871 it became necessary to enlarge the conduit by which the river water was admitted to the basins.

These works are believed to have been the first in America in which the application of natural filter galleries or basins to city supply was attempted.

The Passaic River has a water-shed of 981 miles above Newark. The geological structure of this drainage ground is favorable to the collection of water of great purity, but a few miles above Newark the river receives the drainage and refuse from Paterson and Passaic, towns in which there are about 20 large manufacturing establishments and some 60,000 inhabitants.

The pollution from this source, and from the sewage of Newark, which is carried up by the tide past the pumping works, makes the water used at times unpleasant, if not unwholesome.

In 1879 the experiment was tried of procuring a portion of the water for use from tube wells driven in the gravel plain on the river bank, adjoining the pumping station. Ten 2-in. pipes connected to a suction-main, yielded 700,000 gallons daily for six months. Twenty 3-in. pipes were then driven, and two and a half million gallons per day pumped for several months. In the fall of 1880 forty more tubes were driven, and connection made with one of the five million gallons Worthington pumps. The water obtained in this way was of good quality, and being mixed on nearly equal proportions with the impure river water, greatly improved the quality of the supply to the city.

From the pump-well, which is arranged to draw independently from either of the basins, the water is lifted to the receiving reservoir by three Worthington engines. The first was erected in 1869, and is of five million gallons capacity. The second, put in operation in February, 1871, is a duplicate of the first. The third, put in operation in March, 1875, is a compound engine of eight million gallons capacity. The high-pressure cylinders are 29 in., the low pressure 52 in. and the pumps 28 in. in diameter and 50-in. stroke.

The receiving reservoir, 6,000 ft. from the engine-house, and 165 ft. above high water in the river, is in excavation and embankment, is 285 by 410 ft. at water surface and 20 ft. deep. The slopes are lined with a 12-in. stone wall, laid in cement. The 30-in. pumping main passes under the bottom to the centre, and is turned up, terminating in a bell mouth at 167.5 ft. above high tide. In 1878, during a season of great consumption of water and insufficient capacity of the 24-in. distributing main from the reservoir, this discharge pipe was capped and water pumped for a time, directly into the distribution pipe, under pressure, without passing through the reservoir. An additional 30-in. supply main was laid in 1879.

In 1871-3 a low-service reservoir was built about 3 miles from the receiving reservoir, with its surface 114 ft. above tide. It is circular, 460 ft. in diameter, and 20 ft. deep. Built on the site of an old quarry and its bottom filled in to some depth with stone chips, the puddling on the bottom gave way and the reservoir emptied itself several times. It was several times repaired, but would not hold water at all until all the loose material had been removed from a trench around the base of the banks, carried down to solid rock and filled with puddled clay.

For high-service supply two high-pressure engines, erected about 1870, taking the water from the main pipe, pumped it into a reservoir built in 1871, at 225 ft. above tide. It is 260 by 308 ft., and holds two million gallons. A standpipe annexed enables the pumps to deliver a portion of the water 35 ft. higher than the reservoir.

This reservoir leaked for five years after its construction and was then repaired and made tight.

A Worthington tank engine of three million gallons capacity was erected for the high-service supply in 1876, and a second one in 1881.

All distribution pipes are of cast iron. Considerable trouble was experienced with the small pipes laid by the Aqueduct Company previous to 1870.

They had to be replaced by larger pipe, and by 1876 nearly all of those of 3 in. and less had been removed.

The use of meters was begun in 1873, and there are now about 150 in use.

The population, pipeage and consumption have been as follows:

Year.	Population.	Miles of pipe.	Consumption per day in millions of gallons.
1860	71,941	17.5	1.00
1870	105,542	51.6	2.50
1880	136,400	136.2	9.39

The cost of the works to Dec. 31, 1880, was $2,671,580.40, exclusive of real estate, interest and operation. The outstanding bonds amount to $3,240,000.

The income for 1880 was $312,749.55, and the expenditures $68,682.92 for operation and maintenance and $223,800 for interest.

The works are managed by a board composed of the Mayor and six commissioners, elected by the people, two changing every year.

George H. Bailey, C. E., was Chief Engineer of the work from 1860 to 1877. Until 1875 he was also the Superintendent. Jerome B. Ward was Superintendent from 1875 to 1881.

XV.—LOUISVILLE.

Louisville, Kentucky, in lat. 38° 3′ N., long. 85° 30′ W., on the south bank of the Ohio River, covers 12½ square miles on an elevated plateau 70 ft. above low water in the river. Settled in 1775, its population in 1851 was about 45,000, when it was incorporated as a city.

The Louisville Water Company was chartered in 1854. On Sept. 6, 1856, the city was authorized by a popular vote of 1415 to 370, to subscribe for $550,000 of the stock of the company and issue bonds to that amount.

Works were constructed after the plans of Theodore R. Scowden, C. E., and water was introduced on Oct. 16, 1860. The supply is taken from the Ohio River 1.52 miles above the city limits. The shore is of coarse gravel and the current rapid. A wrought-iron inlet pipe of 50 in. diameter, set in a crib of timber filled in with stone, the mouth of the inlet being 5 × 12 ft. and set 1 ft. below lowest water, conveys the water 300 ft. to two rectangular chambers with which the pump suction-pipes are connected.

By 1865 the inlet pipe was found to be half full of silt, and in 1866 so much trouble was caused by it that a well was sunk over the pipe 105 ft. from its end, intending to cut off the pipe and clean it. Work was stopped by high water, but resumed in 1867 and accomplished. The silt removed was half the capacity of the pipe. The pipe itself was found to be sound outside, and to have some tubercles on the inside, the deepest corrosion being $\frac{1}{16}$ of an inch.

Anchor ice stopped the pumps in Dec., 1870, and the strainer had to be removed temporarily. In Dec., 1874, a stoppage from floating leaves occurred. The pipe was cleansed of sediment again in 1877, when 20 in. in depth had accumulated. The top of the pipe was found to be considerably corroded, in some places ¼ in. deep.

Two Cornish beam engines, with steam cylinders of 70¾-in. diameter and 120-in. stroke and plungers of 36-in. diameter are used.

Stronger columns were put in to support the

*Copyright 1881.

beams in 1879. While this was in progress, two Blake pumps, with 24-in. steam and 16¼-in. water cylinders, and 24-in. stroke were erected for supplementary supply.

The engines pump into a stand-pipe of ⅛ to ¼-in. plate iron, 48 in. diameter and 132 ft. high above the ground, which is 41 ft. above low water in the river. A wooden tower incloses the stand-pipe. An attempt to pump directly into the mains in 1870 resulted in such a ram as to break a 30-in. main. In 1875 an arrangement was made by which water from the stand-pipe overflowed into four 20-in. pipes instead of feeding the mains from its base. This enabled the water to be delivered into the distribution mains without passing through the reservoir and without harm.

A 30-in. main conducts the water 3,650 ft. to the reservoir, built with earth embankments 24 ft. high on the surface of an irregular hill. The water surface, 178 by 374 ft., is 141 ft. above low water.

The bottom of the basin is paved with two courses of brick in cement, laid flat, and the slopes with one course on edge, an inverted arch of brick 9 in. thick connecting the bottom and slope pavements. The water is 19.4 ft. deep. A dividing wall 12 ft. high was built, through which the force main rose to 144 ft. above low water, discharging through a bell mouth.

A second force main was laid in 1869, which was led into a chamber from whence it discharged over a weir 10 ft. long into the reservoir.

In 1862 the outside slopes slid, and 1½ in. sheet piling was driven at right angles to the slope. In 1870 it was found that two springs about 900 ft. from the reservoir had increased in volume at the same time that the amount of water pumped increased, without filling the reservoir. The reservoir was emptied, and a leak was found in the bottom over the pipe laid underneath.

The pipe was then filled around with concrete.

On June 4, 1876, a number of springs appeared at the base of the bluff, in which the reservoir is situated.

On examination of the reservoir an irregular rupture in the bottom of the basin was found, through which the water escaped to the rock, and followed its surface.

A pit about 3½ ft. in diameter was excavated 9 ft. deep, puddled and concreted.

The basins were found to have 5 ft. of sediment in them, amounting to 11,000 cubic yards, which was removed in the following manner. An 18-in. cast-iron ell was placed in the end of the 20-in. drain-pipe, the socket end of the ell being turned up in the drain-well, in which position it was secured.

In the convex side of the ell was cast an orifice 6 in. in diameter, to which was fitted a 6-in. ell with a nozzle 4 in. in diameter, through which a 4-in. stream of water was injected in the line of the axis of the horizontal arm of the 8-in. ell and under a head varying from 28 to 52 ft.

In the upper end of the 8-in. ell was fitted a plate iron hopper or reducer from 36 to 18 in. and resting on a cast-iron curb surrounding the well. Into this hopper the deposit was dumped by the wheelbarrowful, and as it came in contact with the stream of water it was dissolved and carried away by the stream of water as fast as it could be wheeled in. A little water was allowed to run into the hopper at the upper end, so as to lubricate the material in its passage to the ell. After putting up the pipe and getting ready to remove the deposit, it took 139 consecutive hours, with a gang of men, averaging 41 in number, to clean the northerly basin; then, after changing the apparatus to the southerly basin, it took 100 consecutive hours, with a gang, averaging 52, to clean it.

By means of a line of 3-in. hose, a ¾-in. stream of water was constantly applied for the purpose of disintegrating the material so as to enable its being shoveled more easily. While the reservoir was being cleaned the city was supplied by pumping directly into the distribution. A sufficient quantity of water in excess of the demand in the city was pumped to afford the stream for cutting up and carrying out the deposit.

By means of 25. ft addition to the height of the influent pipe of the reservoir, 52 ft. of the head could be obtained for the purpose of disintegrating the deposit as it was wheeled into the hopper.

It was found not necessary, however, to constantly maintain this head.

Crescent Hill reservoir was begun in April, 1877. It is 2¼ miles from the stand-pipe. The water surface is 175 ft. above low water. The capacity is 100,000,000 of gallons.

Water was introduced into it Dec. 15, 1879. Notwithstanding extraordinary care having been taken in the foundations of this reservoir, leaks and slips occurred soon after it was filled.

Distribution mains are of cast iron. Since the spring of 1868 all pipes have been coated with Angus Smith's preparation.

The use of meters was begun in 1862; 62 were in use in 1870 and 201 in 1880.

Hydraulic elevators came into use in 1873. On Jan. 1, 1880, there were 50 in use.

The population, pipeage and consumption have been as follows:

	Population	Miles of Pipe.	Daily consumption in millions of gallons.
1861.....	69,700	26	0.64
1870.....	100,753	58	2.82
1880.....	123,645	110	5.50

The expenses and revenue to Jan. 1, 1880, had been—

Construction.....	$824,759.28
Enlargements.....	2,400,608.74
Interest and taxes.....	1,739,882.51
Maintenance.....	686,813.64
Total.....	$5,631,864.17
Revenue.....	2,122,151.56

The company organization has been maintained, and the works are managed by a board of directors elected by the stockholders.

Charles Hermany, C. E., has been Chief Engineer and General Superintendent since 1861.

(TO BE CONTINUED.)

We acknowledge the receipt of the Ninth Annual Report of the Public Water Board of the city of Lynn, Mass., from Daniel Walden, Superintendent; Annual Report of the Department of City Works of Brooklyn, New York, for year ending Feb. 1, 1881, from Peter Milne, Jr., Water Purveyor; pamphlet describing the public and district sewers of Denver, Colorado, from H. C. Lowrie, City Engineer. Reports of Louisville Water Company for years 1877, 1878 and 1879, from Charles Hermany, Chief Engineer Louisville Water-works. Forty-first annual report of the Water Department of Cincinnati, O., for year ending December 31, 1880, from A. G. Moore, Superintendent and Engineer.

THE WYE LEVEL.

Those who have sought to do extremely accurate leveling have been impressed with the difficulties of the undertaking. In proof that there are real and not imaginary difficulties in the case, reference need only be made to the results obtained by the different national geodetic surveys. Even with extremely great care and superior instruments the results are somewhat discordant.

What follows is essentially a portion of a series of lectures, prepared for the writer's classes. He has good reasons for believing that the points discussed are not fully appreciated by some.

The principal sources of error are, first, the rod not being held vertically; second, the instrument not being properly leveled at the moment of sighting, and third, the instrument not being in adjustment. It is the object of this article to deal only with the third class of errors as above. Since the Y level is the one generally used by engineers, this discussion will be limited to that form of instrument. The principal conditions affecting the accuracy of the work done with a Y level are as follows:

I. The rings should be of the same size, and the wyes should present the same angle in the direction of the telescope tube.

II. The tangent at the middle of the level tube should be parallel to the bottom of the wyes.

III. The optical center of the objective should lie and move in the line of the centers.

IV. The intersection of the cross hairs should lie in the line of the centers of the rings.

The ordinary adjustment of making the line of the bottoms of the wyes perpendicular to the vertical axis, is only for convenience and in no way affects the accuracy of the work.

I. The wyes should have the same angle and the rings should be of exactly the same size. The first is not likely to be in error an appreciable amount. The wyes can easily be compared by taking them off and placing them side by side, or by carefully marking the angle of each upon a piece of paper.

The equality of the rings is a very important matter which is often overlooked; and therefore the accuracy of the engineer's work is made to depend upon that of an unknown workman. The engineer should be able to thoroughly test his instrument for himself. If the rings are not the same size the instrument, in effect, is a "dumpy" level, and must be adjusted and used as such. That is, the telescope must not be reversed in the wyes; and the level must not be adjusted as ordinarily described for the Y level.

There is no way by which the sizes of the ring may be compared, except by the use of some auxiliary instrument. The rings may be compared by calipering; or they may be tested by means of a striding level. But, for the engineer, the most available method is by means of a test level, using the "two-peg method." However, that test can not be made until all the adjustments have been completed.

II. The tangent at the middle of the level tube (the zero of the scale) should be parallel to the bottom of the wyes. This is the ordinary adjustment of the level. It is made in two steps, first to bring the level and axis of the telescope into the same plane, and second to make the level parallel to the bottom of the wyes. The first is made by slightly rotating the telescope in the wyes, and noticing whether the bubble moves longitudinally.

Correct all the error with the azimuth screw of the level tube. If the bubble runs toward the same end when the level is swung on both sides of the vertical it proves that the level tube is conical, and therefore useless. The only remedy is in another tube. The first step cannot be made perfectly until the second is made at least approximately, and vice versa. The second step is made in the usual way by reversing the telescope end for end in the wyes.

III. The object-glass slide (or the slide carrying the cross-hairs) should be straight, and the optical center should move in the line of the centers of the rings. These conditions should be satisfied by the maker; but, since this is not always done, if the engineer would know to a certainty concerning his work he must test these points for himself.

The slide is straight if the optical center moves in two planes at right angles to each other. To test this, set the instrument up firmly, clamp the vertical axis and range in a number of points in the vertical plane of the intersection of the cross-hairs. An easy method of accomplishing this is to set the instrument in a cut or low place, and sight at a

plumb-line and mark the point on the head of a stake. Care must be taken not to disturb the instrument when moving the object-glass slide. The instrument need not be leveled, nor even adjusted in any particular, before making this test. If there is any play or looseness in the object-glass slide it will be almost impossible to make this test satisfactorily. Reverse the telescope in the wyes by turning it upside down; and, if necessary, turn the instrument on the vertical axis until the intersection of the cross-hairs is in a vertical plane with the first point established. Then range in other points at distances corresponding to those already established. Measure the distance between each pair of points. If these distances are proportional to the distances of the respective points from the first one, then the optical center moves in a plane. The motion in a plane at right angles to this may be examined in the same way. If the optical center moves in two planes at the same time the slide must be straight.

The second condition, that "the optical center should move in the line of the center of the rings," can only be tested in connection with the adjustment of the line of collimation, which we will not describe.

IV. The intersection of the cross-hairs should lie in the line of the centers of the rings. The first step of this adjustment is made in the usual manner by sighting upon any well-defined point, rotating the telescope in the wyes and correcting half the error.

When the instrument has been collimated for some particular distance focus upon some other point, and find whether the instrument is collimated for the second point. The greater the difference in the distances of the points from the instrument the better. If the instrument is not in adjustment for the second point the error may be caused either by the optical center not lying in the axis of the rings or by the line of motion not being parallel to axis of the rings. The engineer has no means of determining which it is, except by trial. The former may be caused by the optical center not lying in the center of figure, or by the telescope tube not being straight.

With an instrument which is provided with a means of adjusting the direction of motion the engineer may move the inner ends of the object-glass slide until half the error is corrected. Collimate again upon the first point, and then test the adjustment for the second point. Then if the instrument is in adjustment for the two points at the same time it is probable that the optical center lies in the axis of the rings, and also that the direction of motion coincides with the same line. It is generally stated that if an instrument is in collimation for two different distances at the same time the line of sight must be in the axis of the rings; but this is not necessarily true.

In general, if either the intersection of the cross-hair or the optical center of the objective does not lie in the axis of the rings, the line of collimation will describe the surface of a cone, when the telescope is revolved in the wyes. For any given position of the optical center it is possible to have a corresponding position of the cross-hairs and motion of the objective (or cross-hairs), such that the instrument may be in collimation for two points at the same time, and still the line of collimation will not lie in the axis of the rings. That is, if the instrument is not in collimation the line of collimation will describe the surface of a variable cone, of which the points collimated upon will be two positions of the vertex. Such a relation of parts could only be obtained by a series of successive approximations. The only check against the occurrence of this condition is a test level by the so-called "two-peg method."

Another particular case of the cone described by the line of collimation is that in which the optical center and intersection of the cross-hairs are on the same side of and at the same distance from the axis of the rings. The surface described by the line of collimation then becomes a cylinder; this state of affairs will be revealed by the instrument being out of collimation the same amount for all distances. In this case the line of collimation will be parallel to the level (assuming the rings to have been found to be the same size and therefore capable of doing correct work). In case the optical center does not lie in the line of the centers of the rings the cross-hairs may be moved, by a series of trials, until the line of collimation shall describe the surface of a cylinder. This last case can only occur in those instruments in which the line of motion coincides with the axis of the rings.

After having made the usual adjustments of the Y level, it is absolutely necessary that they should be verified by taking a test level. This test level is to be made by what is known as the "two-peg method." Drive two pegs into the ground, set the instrument exactly half way between them and determine the difference of level as in ordinary leveling. Then set the level near one of the points and redetermine the difference of level. If this difference is the same both times, it is *certain* that all the adjustments enumerated above have been correctly made. That is, this test level proves (1): That the object-glass slide is straight; (2) that the line of motion of the objective is parallel to the line of the centers of the rings; (3) that the rings are of the same size; (4) that the level is parallel to the bottom of the wyes; and (5) that the line of collimation is parallel to the line of the center of the rings.

If the differences are not the same, the error may result from a defect in any of the above five conditions. If the first is in error, the only remedy is in a new instrument. If the second is in error, some instruments are provided with a means changing the direction of motion; however, it is at least doubtful whether this is any advantage to an instrument. When no means of adjustment is provided, the only remedy is in a new instrument. If the third is in error, the instrument can be adjusted and used as a "dumpy" level. If the fourth or fifth is in error, a readjustment is sufficient.

I. O. B.

Illinois Industrial University, Champaign, Ill.

CORRESPONDENCE.

ANSWER TO CORRESPONDENT.

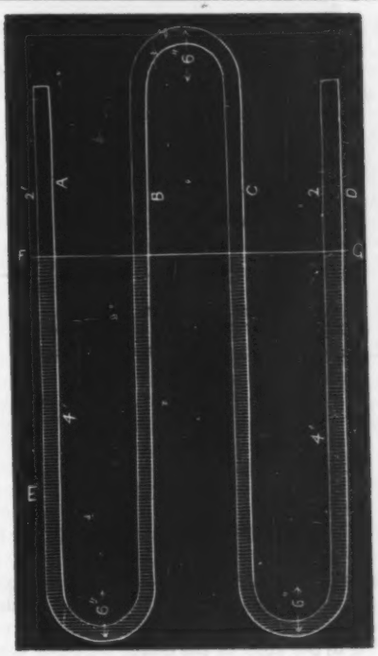
U. S. Engineer's Office.—Can you tell us in ENGINEERING NEWS who manufactures a 2-ft. rule divided by feet and tenths? A. The Stanley Rule and Level Company, of this city, make a 2-ft. rule graduated to feet and tenths upon its edge.

PROBLEM IN HYDROSTATICS.

FORT EDWARD, April 11.

EDITOR ENGINEERING NEWS:

I would like to submit to the profession, through your valuable paper, the following problem for solution: The straight parts of the several branches of pipe in the diagram are 6 ft. each, the curves connecting them are 6-in. radius to the center of the pipe. Each of the straight branches is filled with 4 ft. depth of water. Now, if an opening be made at *E*, 3 ft. below the surface and the water allowed to discharge all that will run, how much in length of column of the pipe will be discharged and what will be the position of the surface in the several branches in respect to the line *FG*, the two outside branches being open at top? Also, required an algebraic formula for determining



the height of the several columns, taking into account the law of Mariotte. AQUARIUS.

FIELD BOOK AND LOGARITHMS.

NO. 3.

IOWA CITY, April 19, 1881.

Mr. Searles again appears in the NEWS of April 9 in defense of logarithms. I shall try to fairly but freely, expose at least a part of his errors and erroneous views in reference to this very important subject.

I did not depart even a shadow of a shade from the problem proposed, and my purpose was to give just what was called for, the "shortest and simplest method," caring, at the time, not the least for "any other set of values."

Moreover, I compared the two solutions to precisely the same extent—the finding of one side—and therefore any intimation to the contrary is entirely without foundation.

But let us compare general solutions:

Let *AP* be the 2° and *PB* the 1° curve. $AR = R_1$ and $PO = R_2$ their radii, etc. Also $BCE =$

$ARK = \triangle_1$ and $PRK = POH = \triangle_2$. Prolong the curve AP to K, RK being parallel to OB; and draw the tangent HKD tangent to APK at K.

$$\text{Now } BH = BO - RK$$
$$-OL = R_2 - R_1 (1 + \cos. \triangle_2).$$
$$CD = \frac{BH}{\sin. \triangle} = \frac{R_2 - R_1 (1 + \cos. \triangle_2)}{\sin. \triangle}$$
$$AD = R_1 \text{ tangent } \tfrac{1}{2} \triangle = R_1 \frac{1 - \cos. \triangle}{\sin. \triangle}$$
$$\therefore AC = AD + CD = \frac{R_2 - R_1 (\cos. \triangle + \cos. \triangle_2)}{\sin. \triangle}$$
$$= [R_2 - R_1 (\cos. \triangle + \cos. \triangle_2)] \operatorname{cosec} \triangle.$$
$$= (5{,}729.65 - 2{,}864.93 \times 1.43969)\ 1.1547.$$

The process by multiplication is as follows:

$$\begin{array}{r} 2{,}864.9 \\ 7{,}934.1 \\ \hline 2{,}864.9 \\ 1{,}146.0 \\ 113.6 \\ \hline -4{,}124.5 + 5{,}729.6 = 1{,}605.1 \\ 7{,}451.1 \\ \hline 1{,}605.1 \\ 160.5 \\ 87.7 \\ \hline 1{,}853.3 \end{array}$$

It will be observed that the order of the figures of the multiplier is inverted; the partial products moved successively to the *right*, the parts of each falling to the right of the tenths not being found.

With a table of proportional parts to four places to correspond to a logarithmic table to the same extent, the process would be as follow:

$$\begin{array}{r} 2{,}864.9 \\ 1{,}146.0 \\ 113.6 \\ \hline 4{,}124.5 + 5{,}729.6 = 1{,}605.1 \\ 160.5 \\ 87.7 \\ \hline 1853.3 \end{array}$$

Since $2{,}864.9 \times 1 = 2{,}864.9$ it is not necessary to enter the table for it.

Then $2{,}864 \times 4 = 11{,}456$ is found opposite 2,864 and under 4, 4 being added from 9×4.

The last three partial products are mentally added before writing down. Thus, in the second multiplication, $802 + 64 + 11 = 877$. This requires a "mental effort of which the average schoolboy is perfectly capable," and occurs but *twice* in the above process, while Mr. Searles for *each* logarithm he finds (see his solution in NEWS for March 19) mentally adds two partial products to the partial logarithm for the complete logarithm.

So for each number found from its logarithm he must: (1) Find the difference of two logarithms. (2) Find, by inspection, a number in the table next less than this difference, and take the figure at the head of the column for the fifth figure of the number. (3) Substract the number from the difference. (4) Find a number, one-tenth of which approximates this last result, and take the figure at the head of the column for the sixth figure of the number.

I cheerfully admit that these "interpolations are by no means formidable;" but they are numerous, time-consuming, and cannot be disregarded.

My solution is written out as completely as his, while, as we have seen, very many operations occur in his for which there is no equivalent in mine. I require 41 figures, less than one-third of 143. I have one subtraction and four additions, while Mr. Searles has—well, I do not care to count them.

But the natural solution would be the shorter, unless the number of figures was very many more than in the logarithms; since the labor, aside from writing down the figures, is slight in the natural method. Were there six times 41 in the above, it would still be shorter than his. Indeed, one could effect the above solution, and locate, at least, one branch of the curve, before any one could go through with the logarithms elaborations and complications of the other. Let me add that one tangent is all that is required in laying out the curve; and furthermore that $A\,P$ *can* be (and was on the MS.) prolonged to the point K, which, of course, is not on $P\,B$. $D\,K\,H$ was drawn tangent to the curve at K.

Let us glance at the approximate solution. I find no fault with his formulæ. I use such myself. I have others equally good, that I recommend to my "own classes," and to any one who may be in sore need, and who may be obliged to resort to *my formulæ* in order to appear in a respectable mathematical dress. Any one who will use such formulæ, in a direct and natural manner, will find his results, and frequently lay out his work, while the advocate of the devious, round about and entangled processes will be found "under the kindly shade of some neighboring tree," elaborating his "fifteen lines and two columns," involving labor sufficient to solve the problem many times; and all because he will not sacrifice a prejudice in favor of logarithms, amounting almost to a superstitious reverence.

Using four places, the formula becomes $2{,}865 \times 5{,}603 \times 1.155$, and the process is:

$$\begin{array}{r} 1{,}432.5 \\ 172.7 \\ \hline 1{,}605.0 \\ 160.5 \\ 88 \\ \hline 1{,}853.5 \end{array}$$

There are two additions; and 24 figures are required—not 69 as reported.

Again, in evoluting Mr. Searles' solution, I counted *complete* products only; while in mine he counts *partial* products. But as *no* multiplications are required, he is welcome to all he has made by such shrewdness (?).

Now, as regards the merits or demerits of logarithms: They are exponents and useful in solving exponential equations, and for finding the higher powers and roots, in certain cases. But a table of squares, etc., to say nothing of other tables, justly meets the demand in this direction, not only in field computations but generally in *all* computations. If Mr. Searles knows of a useful application of logarithms, why does he not produce it, instead of his hypothetical "ifs" and "ands," and his encomiums on the "enthusiasm" of men who lived centuries ago?

That men fritter and squander away their time on trigonometric and other computations proves nothing.

It is because I care nothing for the opinions of any one, further than they accord with the strongest evidence obtainable, or can be supported by facts, that I have been able to weigh the question, and discover for a certainty that generally, in all actual computation, it is impossible, in the nature of things, to take a single step by means of logarithms. Nor am I interested in what Mr. Searles has "experienced" in the matter. This is not an experience meeting. I would give more for a single fact on either side than the imagined experience of the whole world. The abandonment of logarithms by their advocates, in the multiplications and divisions that arise incidentally in the use of them, is ridiculously inconsistent, and is a virtual abandonment of their claims.

But even Mr. Searles does this, and thinks there is so little labor in obtaining these products and quotients, *without* logarithms, that it is hardly worth regarding.

Logarithms do not, in general, "avoid multiplications and divisions," they simply introduce other multiplications and divisions which the computer performs, with several other processes, and then imagines that logarithms have done the work.

Approximate results are sometimes more accurate than logarithms founded on true equations, for the reason that the error in the logarithm, even if true to the last figure expressed, gives a greater *resulting* error in the natural number than does the approximate formula.

A logarithmic solution is an indirect and mongrel affair, and, for that reason, more or less erroneous.

I claim no more for one table than another constructed on the same plan, and I claim the right to use any natural table to the same extent as the logarithmic table used.

The inaccuracy of logarithmic processes is, I think, well illustrated by the foregoing solutions. I lack time for verification, but, in the light of the above facts, feel confident that the logarithmic solutions give results furthest from the true result, and in proportion to their length.

Logarithms, so far as all ordinary operations are concerned, should be looked upon as mere mathematical curiosities, and of no more use than magic squares (nor half so much).

It is because I am not in favor of needlessly increasing the labor of computations that I make no use of logarithms, and advise the rising generation to do the same. If any one thinks me in error, let him bring facts in support of it—not opinions.

P. H. PHILBRICK.

ENGINEERS' SOCIETIES.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

A regular meeting of the Society was held on Wednesday evening, at the rooms in the new house, No. 127 East 23d street, Vice-President Greene in the chair. After the approval of the minutes of the preceding meeting the Secretary formally announced to the members that the Society had purchased the house in which they were assembled for $30,000 on very favorable terms, which were stated by the Secretary, who also referred to the excellent condition of the building, its capacity and convenience of arrangement for the purposes of the Society and the general satisfaction as to the purchase. In answer to a question by Chief Engineer Greene, of the N. Y. Dock Department, as to the ability "to withstand wind pressure," the Secretary replied that he believed the strain had been estimated and the building considered safe on that point. The Secretary announced that very favorable rates of transportation for members to the Convention, to Niagara Falls by rail, and thence to Montreal by steamer, had been obtained, which would be announced at the proper time. The following gentlemen were elected:

MEMBERS.

Truman Heminway Aldrich, Mining Engineer, Montevallo Coal Mines, Shelby Co., Ala.

William H. Atwood, Resident Engineer, New York, Ontario & Western R. R., Jersey City, N. J.

George P. Bland (elected Junior April 7, 1875), Engineer Philadelphia Bridge Works, Philadelphia, Pa.

Edwin Eagling Glaskin (elected Junior April 5, 1876), London, England.

George Thomas Keith, Civil Engineer, Olean, N. Y.

Sidney Francis Lewis, Asst. State Engineer, New Orleans, La.

Henry S. Munroe, Adjunct Professor of Surveying and Practical Mining, School of Mines, Columbia College, New York.

Albert Chapman Savage, Engineer Construction Subdiv. Texas & Pacific Railway, Belle Plain, Texas.

William Newton Symington, Consulting Mining Engineer and Metallurgist, New York City, N. Y.

Arthur Mellen Wellington, Locating Engineer in general charge Mexican National Railroad, Laredo, Mexico.

Samuel Whinery (elected Junior April 1, 1874), Asst. Engineer New Orleans & North Eastern Railroad, Meridian, Miss.

ASSOCIATE.

Arba Read Haddock, Mech. Eng., Merchant, New York City, N. Y.

JUNIORS.

Charles Addison Ferry, Asst. Eng. in charge sewer construction, New Haven, Conn.

Charles J. Peetsch, Asst. City Engineer, Milwaukee, Wis.

On account of the labor incident in the removal of the effects of the Society from its lately-occu-

pied rooms to its present quarters, and the arrangement of the same, the Secretary had not arranged for a paper to be read at this meeting, but it was announced that at the meeting of May 18 a paper by Charles L. McAlpine, Member Am. Soc. C. E., subject, "Quicksand in Excavation," will be read and discussed.

The following gentlemen have been elected to the Society:

Jan. 5—As members: William Roberts Eckert, of San Francisco, Cal.; John Simpson Walker, of Wheeler, Ala., and Francis Melton Wiltier, of Binghamton, N. Y. As juniors: Arthur Vaughan Abbott, of Brooklyn, N. Y., and John William Ferguson, of Rutherford, N. J.

Feb. 2—As members: Nathaniel Webster Ellis, of New York City, and Lewis Randolph McLain, of Bay Island, Va.

March 2—As members: William Archer, Cincinnati, O.; Henry A. Bentley, Providence, R. I.; Theodore N. Ely, Altoona, Pa.; Benjamin Reece, Toledo, O., and Sebastian Wimmer, New York City. As juniors: Wm. M. Allaire, New York City; Ward Baldwin, Cincinnati, O., and Francis N. Holbrook, Brooklyn, N. Y.

April 5—As member, Charles Rufus Boyd, Civil and Mining Engineer, Wytheville, Va.; as associate, Henry H. Gorringe, Lieut.-Commander, U. S. Navy, New York; as junior, Edward Butts, Prin. Asst. Engineer, Kansas Div. Union Pacific R. R., Kansas City, Mo.

At this meeting Mr. Francis Collingwood read a paper on "An Examination into the Method of Determining Wind Pressures."

At the meeting April 20th, G. Thomas Hall read a paper on "The Construction of the Second Avenue Line of the Metropolitan Elevated R. R. of New York City," which may be considered the most accurate and faithful description of that structure that will probably ever be published.

The Society is to be congratulated on the purchase of its new quarters to which it has removed. The rooms lately occupied were very circumscribed as to space, and the accumulations of the Society rendered more spacious rooms an absolute necessity. The present purchase is on such favorable terms that the rent account is reduced, all necessary room and conveniences are assured, the Society has now a "local habitation" as well as a name, of which its members may be proud, new importance is added to the Society by reason of its being a landed proprietor of a considerable property, and we are certain that every individual member will take pride in this added evidence of the prosperity of the profession, one sign of which is the ability of the National Society to assume the obligations incident to its new purchase. A building fund has been established for the purpose of taking care of the debt on the building as it matures. The Society has many members who are considered wealthy men, and of the rest, scarcely any but are able to contribute something to advance the dignity and importance of their profession to the position to which it is entitled. It is to be hoped that no mere circumstance of remoteness from head-quarters may render out of-town members lukewarm in their regard for the common welfare of the Society, but that they will feel a personal interest in contributing to the special fund to clear off the indebtedness of their new home.

LIVERPOOL ENGINEERING SOCIETY.

At the usual fortnightly meeting of the Liverpool Engineering Society, held at the Royal Institution in Colquitt street on Wednesday, the 13th April, a paper by Mr. G. C. Thompson on "The Application of Natural Force to the Production of Motive Power" was, in the unavoidable absence of the author, read by the honorable secretary.

The author treated his subject in a general manner without going extensively into detail, dwelling for a considerable period on the possibility of much mechanical knowledge possessed by the ancients being lost at the present day, citing as a proof the ruins of Baalbec, where some of the stones employed in construction, according to the author's calculation, must have weighed 840 tons, and required the united strength of 25,000 men to lift into position. Having pointed out some obvious disadvantages in the use of steam and its substitutes, the paper suggested the use of compressed air, to be obtained by automatically utilizing the rise and fall of the tide, according to a detailed description and diagram, the main feature of which was the enclosure of 20 acres of coast land and the formation of a large air-tight space to be acted upon by the tide, which, on rising, would pass through an inlet pipe and force the compressed air through an outlet pipe at the upper and opposite side, when it would become a prime motor.

The second portion treated of the utilization of the wind by means of windmills and pumps for effecting a similar purpose.

A discussion followed and a vote of thanks to the author for his interesting paper was passed by acclamation.

BOOK NOTICE.

Index to the Library of the American Society of Civil Engineers. Part I. Railroads. Prepared under direction of the Committee on Library. New York. Published by the Society, 1881.

We believe that most members of the American Society received this book with great curiosity as well as pleasure. They had a vague idea that the Society had a library, but many of those who were non-residents of New York have never had an opportunity to consult its shelves, and while feeling sure that it must have accumulated a valuable stock of works of reference, yet felt themselves in the position of the man who knows he is rich in unproductive real estate, but whose investments are not available for ready money. Now, however, a portion of its treasures is laid before us, and we are confident that some engineers will find it profitable to travel a considerable distance to consult it. The index itself is not a mere catalogue of titles, but is an *intelligent* index, which gives an idea of the contents of the volumes, and with cross references, so that a subject can be found under several heads. It represents an immense amount of labor, on the part of the Chairman of the Committee on Library, Mr. J. J. R. Croes, and especially deserves the thanks of every member of the society, since its compilation was undertaken purely from a personal interest in the welfare of the Society and its library and has been a labor of love.

In glancing through the pages we may note some of the books which we think it will be difficult to obtain elsewhere, on subjects that are now attracting attention. A short time ago there appeared in a contemporary journal an article on a curve of adjustment for connecting a curve with a tangent, so that the elevation of the outer rail and the curvature could be gradually and proportionally obtained. A cubical parabola was the curve recommended. In the index we find the methods of Messrs. Gravatt and Froude, both published about twenty years ago, and of which the latter is better than the cubical parabola. We also find the experiments of Messrs. McCallum and Wellington on the resistance of curves, and a rule of Mr. Huss for the equation of curves with grades. We regret, however, to find that there is no record of the experiments of Mr. Latrobe, made on the Baltimore & Ohio Railroad many years ago, and whose results agreed with the rule adopted by Mr. Thomson in locating the Pennsylvania Railroad over the Allegheny Mountains, viz.: to reduce the maximum grade $\frac{1}{116}$ per 100 for each degree of curve. It is possible, however, that these experiments may be detailed in some of the Baltimore & Ohio Railroad Company's reports, of which there are a number in the library.

Bridge engineers will be glad to find the oft-quoted report of the Parliamentary Commissioners to inquire into the application of iron to railway structures, in which are given the experiments which show that a load suddenly applied produces the same effect as twice the same load applied gradually, and which is one of the chief elements in the "factor of safety" which is always used, and which is not so much a "factor of ignorance," as some suppose.

We also find Parliamentary reports on averting bridge accidents, and an atlas of drawings of the Tay bridge, the latter being specially interesting since the sketches which appeared in the technical journals were rather pictorial than practical in showing the weakness of that structure.

The so-called mechanical branch of the profession can likewise find much interesting matter. There is a description of Le Chatelier's method of employing the counter-pressure of the steam as a brake, a method which has been very satisfactorily employed for some years in this country by Mr. Myers, on the Richmond, Fredericksburg & Potomac Railroad. We also find papers on Mallet's system of compounding locomotive engines, which will probably be novel to many master mechanics. Numerous experiments are likewise given of the slipping of the driving wheels, which we think is interesting to this branch of our profession. There is a good deal of information on rope tramways and rack-rail roads.

Railroad superintendents will find the rules for running trains on the Pennsylvania and Philadelphia & Reading railroads.

Engineers of maintenance of way will find a great deal with reference to strength of rail joints, forms of rails and signals. The railroad historian will find an immense amount of material in the invention of bogie trucks, air brakes, elevated railroads, use of anthracite for locomotives, etc.

We are glad to see that the library possesses a copy of Col. Long's manual, the precursor and model of the many pocket-books which have since appeared. We should have liked to see more of these pocket-books, but suppose they are considered less valuable in a library of reference, since every engineer has in his own library those which he thinks the best. We are likewise sorry that there were not more works on the subject of the calculation of excavation and embankment, so that a history of the subject could have been made. Lyon's excellent tables are wanting; Warner and Morris on earthwork would be good additions. Holley's "American Railway Practice," we think, should likewise be on the shelves. For the sake of the statistician, many of the railway reports should be made complete by those members whose connection with railroads would readily enable them to do so. The new quarters of the society are sufficiently ample to store the immense accumulation of material, if all the members should send the reports of the companies with which they may be connected, and although many may think that it were better not to encourage the accumulation of much that will in a few years be regarded as trash by most of them, yet there should be some place where the future statistician could find materials for the study of railroads, and it seems that this library should be the appropriate place. It will probably be noticed that those men who are most successful in acquiring control of the great railroad properties, and are beginning to startle thinking men by their enormous riches, which may easily become a most serious danger to the future success of the Republic, are those who study the statistics of the country, and by "discounting" the growing prosperity of a section, are enabled to obtain the full benefit of the advance in values.

In closing this rather lengthy notice, we shall call attention to the fact that the index itself is the only one which serves for the scattered papers of the different societies which exchange publications, and as such must be very valuable to any one who wishes to learn the latest knowledge on any engineering subject. The library is an excellent nucleus, in the railroad section, for the perfect library that we hope to see it become, and we look forward with interest to the indexes of the bridge and water-works sections, and hope they may be made by the same competent hands.

T. M. C.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The Brookline reservoir, that forms part of Boston's water system, has just been cleared for the first time since 1854.

The storage reservoir at Hempstead, L. I., from which Brooklyn obtains a portion of its water supply, contains at present 1,000,000,000 gallons.

"Water—How its supply is regulated in Eastern Cities," is the title of a neat and valuable pamphlet of eight pages, which will be mailed free from this office to any parties applying for it.

Nathaniel Creager has been chosen as superintendent of construction of filter galleries, pumping-house, stand-pipe, etc., of the Springfield, O., water-works, at $3 per day, his services to commence May 1.

The Deane Steam Pump Company have just shipped a large mining pump to the works of the Hibbard Antimony Company, in New Brunswick, sold through the Boston agent, A. F. Upton, 7 Oliver street.

The water question is now being mooted in East Stroudsburg, Pa. The place has several good hotels, several manufactories, and a large number of frame houses, but no protection against fire as far as convenient water is concerned.

City Engineer Cregier, of Chicago, will soon advertise for bids for the construction of the new Bridgeport engines. The Mayor does not seem to know whether they will be put up this year, and he is anxiously awaiting some action by the Legislatures to help in the work.

The committee appointed at the last town meeting to plan a reliable water supply for Easthampton, Mass., have decided upon the Parsons brook which heads up west of West Farms, and another having its head at the north end of Pomeroy's Mountain, both emptying into the Manhan River, as available, and will have them surveyed at once.

A plan showing the location of the pipes and hydrants of the proposed water-works at Parkdale, Ont., has been hanging in the post-office for over a week. A good many ratepayers have been interviewed on the subject, and so far none have expressed opposition to the scheme. The Council are thoroughly unanimous for having the works constructed at once, and everything looks favorable for passing the by-law, which will soon be submitted to the people.

The proposals received May 2 for the construction of the Norwich, N. Y., water-works were as follows:

R. D. Wood & Co., Philadelphia	$23,000.00
H. M. Geer, Troy	19,780.00
Geo. Tubbs & Co., Rochester	18,867.00
W. B. Cooper, Fort Edward	23,200.00
Stanton & Boyle, Cohoes	18,984.61
Rexford & Jaromb, N. Y. City	19,100.00
Geo. Petterson, Lockport	27,800.00
Warren Iron Foundry	25,000.00

At a meeting of the City Council, Springfield, O., held on Friday evening, April 29, the contract and bond of Eugene Buckley of Cincinnati, O., for pipelaying, was rejected by a unanimous vote. Mr. Buckley's contract for pipelaying was about $54,000; he also has the contract for excavations and foundations for the stand-pipe. Thos. Carothers, representing Carothers & Clough, Newport, Ky., next lowest bidders to Buckley, was at the meeting of the Council and made a proposition to do the pipelaying at Buckley's figures and furnish securities sworn as to extent of their responsibility. The Council Committee of the Whole, after visiting several locations, decided to adopt the "Mitchell tract on Buck Creek between the C. S. & C. R. R.," some 50 acres, for stand-pipe and pumping-house purposes.

The Union Water-Meter Company, of Worcester, Mass., have just issued a new circular of fifteen pages, of which their own advertisement occupies but three; the remaining pages discuss the advantages of the use of water-meters by the comparison of results in Milwaukee, Wis., and Providence, R. I.; "Popular Errors in Relation to Waste of Water;" "Wastage for Protecting Service Pipes from Freezing;" "Waste from Concealed Leaks;" "The Meter System of Worcester, Mass.;" "The Meter System of Providence, R. I.," and the "City of Boston Water Suply," which, giving statistics from the standpoint of such practical men as Messrs. Ball & Fitts, of Worcester, are of daily value to all who are interested in water-works matters. The circular can be had on application to the company at 31 Herman St., Worcester.

Referring to the sanitary condition of Chicago, the *Daily News* says editorially: The death rate of Chicago is greater now than it has been at any time for many years past. The health of the city is worse than it has been for many years. The mortality among children is simply frightful, while grown people are suffering and dying from lung and bowel complaints in every section of the city. Our drinking water is unfit for use. It is breeding disease that may not develop in a day or in a month, but which will surely develop in time. Our streets and alleys are reeking with filth. Our sewerage system is incomplete and imperfect. What threatens to be a wet and sickly summer is approaching, and we are not doing anything to prepare the city for it. A few scavengers are employed here and there, merely as a matter of form, to scrape the dirt off the business streets; but this is merely child's play.

Mayor Grace, Comptroller Campbell and Commissioner of Public Works Thompson, the New York City Gas Commission, have made the following awards for lighting the public lamps for one year from May 1: New York Gas-Light Company—All the lamps south of Grand street, at $17.50 a lamp; Manhattan Gas-Light Company—All the lamps between Grand street and Thirty-fourth street, at $17.50 a lamp; Metropolitan Gas-Light Company—Part of the lamps between Thirty-fourth and Seventy-ninth streets, at $17.50 a lamp; Mutual Gas-Light Company—Part of the lamps between Thirty-fourth and Seventy-ninth streets, and the lamps in the public parks between Grand and Thirty-fourth streets, at $17.50 a lamp; Harlem Gas-Light Company—Lamps between Seventy-ninth street and the Harlem River, at $19.50 a lamp; Central Gas-Light Company—All the lamps in the Twenty-third ward, at $29 a lamp; Northern Gas-Light Company—A part of the lamps in the Twenty-fourth ward, at $32 a lamp; Yonkers Gas-Light Company—Lamps in the Twenty-fourth ward, at $30 each.

BATTLE CREEK, Mich., April 29.—The worst case of typhoid fever known here this year comes from the Village of Ceresco, six miles west of here. A family by the name of Weaver live in a log hut in the center of a marsh upon a raised island. There were eight persons in the family—six children and the parents. They have obtained their drinking water from a barrel sunk into the ground, into which flowed the water of the marsh, pregnant with miasma. During the winter the ice purified the water, but now that warm weather has set in the entire family have been stricken with the fatal disease, and yesterday, during twenty-four hours, three of the children died, and to-day two more, making five deaths in two days. The remaining child is not expected to live, and the parents are very sick. The first that was known of the matter was their applying a few days ago to the Poormaster for assistance, and when their condition was ascertained a physician was immediately called. When taken with the fever they vomit terribly, and convulsions soon follow ending by their death. Immediately after their death the bodies all turn black, indicating that it is the most virulent form of the disease.

UNITED STATES ENGINEER'S TEST OF A DEANE STEAM PUMP.—Office of Chief Engineer of U. S. Navy Yard, League Island, Penn.—*Sir:* In obedience to your order of the 11th inst. we have carefully and thoroughly tested the steam pump sent to the Navy Yard by the Deane Steam Pump Company, and respectfully report. The dimensions of the pump are as follows, viz.: Diameter of steam cylinder, 5 inches, diameter of water cylinder 3¼ inches, stroke 7 inches. It was designed for feeding boilers or forcing water under heavy pressure. Its performance under various speeds of piston and forcing water under varying pressures was excellent. "The Deane" pump, in its mechanical features, particularly the valve arrangement, is *simple, effective* and *positive*. The material and workmanship are *first class throughout*. It is, in our opinion, equal in all respects to the best direct-acting steam pump now in general use, and can be advantageously used for most purposes coming under the cognizance of the bureau.

Very respectfully,
Your obedient servants,
H. H. STEWART, Chief Engineer, U. S. N.
JACKSON MCELWELL, Chief Engineer, U. S. N.
P. M. FULMER, P. Asst. Engineer, U. S. N.
Commodore EDWARD SIMPSON, U. S. N., Comdt. Navy Yard, League Island, Penn.

Charles B. Pratt, Esq., President of the National Fire Insurance Company, and ex-Mayor of Worcester, speaks as follows: "I could not say anything but what would be favorable to the use of meters. I know that I save fully fifty per cent. by the system. I paid $32 a year for water at my residence under the regular rate plan, and it costs me now $15. There is no difference in the quantity used. My family are not restricted in its use. We use a sprinkler liberally in the garden and elsewhere, and use fully as much as we did before a meter was put on. So far as regards their influence upon health, I don't believe they affect it in the slightest degree. I am heartily in favor of their use, and I believe that both the city and the consumer are benefited by it. The reckless waste of water is checked, and on the whole the benefit to the city, to the taxpayer and to the consumer is mutual." George Tower, proprietor of the Lincoln House, one of the prominent hotels in Worcester, gives the following as his views upon the subject: "My opinion is that the furnishing of water by meter is the fairest and most satisfactory way. Under the old system of paying by tariff, my bills were double what they are now. In fact, the expense became so onorous that I requested the Water Board to put on a meter, because I was satisfied that I was being charged for a great deal more water than I was using. When the meter was attached, the difference was apparent at once. Now I think now bills are about $90 a year. Formerly they ran over $200. My hotel will accommodate about 100 guests. I do not restrict the use of water in any way. My help and guests have all they require. In fact, I do not force any economy in that respect. Of course my fixtures are all arranged so as to prevent any waste, but I have never given any orders, nor do I exercise any supervision whatever over the consumption of water. Nothing would induce me to go back to the old system."—*Brooklyn Times.*

WASTE FROM CONCEALED LEAKS.—One source of waste is from concealed leaks in service pipes, which occur in locations where the wasting water finds an outlet covered from sight into a sewer or drain. The use of meters enable wastes of this class to be detected and stopped. The following is an example in point, showing how water may waste for years upon premises occupied by the most prudent and careful persons without their knowledge, and which waste, were it known to the occupant, would not be allowed to run a day. If a meter is in use on the premises, all such leaks become known at once. In setting a meter at a dwelling house a few years ago in the city of Worcester, the mechanic doing the work discovered a leak in a waste stop that was operated by hand to flush out a sort of hopper water closet whenever it was used. The stop was located near the drain that ran from the water closet to the public sewer. The stop was leaking nearly one-half the size of the service which supplied the water, the waste water finding its way directly into the drain. The quantity wasting was adjudged to be not less than five thousand gallons in twenty-four hours, or 1,825,000 gallons per year. By reference to the time the stop had been in use, and taking into account the quality of stop when new, the time that this stop had been leaking was estimated at five years. This time would give 9,125,000 gallons wasted from this single stop. The value of the water wasted, at 15 cents per 1,000 gallons, would be $1,368. This waste was found upon the estate of a very prudent citizen, who would never allow it to have gone on had he been knowing to it. A family of five persons using thirty gallons each, or 150 gallons in all per day, require but 54,750 gallons for a year's supply. At this rate of consumption the waste here cited would supply one family for 166 years, or 166 families for one year, or 35 families each during the five years the waste had been running. But for the meter system adopted by the city the leak would have run on indefinitely, for it was concealed about five feet under ground. This is only one instance of many of a like character, which the meter system has detected and corrected. In connection with this subject, Mr. J. Stewart Brown, the Water Registrar for the City of Worcester, Mass., in his report of November 30, 1878, says: "The Department deems the use of meters absolutely essential as a protection against the waste of water. As heretofore, leakages and deliberate wastes have been disclosed, which otherwise would have assumed formidable proportions. In this respect alone meters prove valuable auxiliaries to the Department."—*Union Water Meter Co.'s Circular.*

STREETS, DRAINAGE, ETC.

The New Orleans City Council has passed and the Mayor has approved an ordinance providing for the Waring system of drainage for that city. It makes a contract with a company which is to lay the streets with sewers leading to a capacious reservoir outside the city. The sewers are to convey the sewage to this reservoir, and from thence it is to be pumped into the river and disposed of forever. The whole system of works is to be completed in five years. The reservoir, the pumping machinery, the main sewer and the pipes for the one-fifth area of the city to be laid down the first year will, it is estimated, cost $1,500,000. There are doubts about the feasibility of the project, and a protest, signed by a great number of citizens, against the ordinance was sent in to the Council. Nevertheless it is a law.

The following comparative table on the sewerage of the cities named is of interest. It shows that the city of Chicago, fourth on the list as regards population, and seventh as regards age, occupies the first place in linear feet of sewerage, finished and in use, per head of population:

CITIES, DEC. 31, 1880.	Area in acres.	Population by census of 1880.	Density of population per acre.	Linear feet of sewers per head of population.
New York	26,401	1,206,577	45.70	1.09
Philadelphia	82,803	846,980	10.23	1.25
Brooklyn	13,338	566,689	42.49	2.81
Chicago	22,707	503,501	22.00	3.54
Boston	4,416	362,535	82.00	2.91
St. Louis	40,000	350,522	8.76	3.04
Cincinnati	15,300	255,707	16.64	0.98
San Francisco	26,880	233,965	8.70	2.82

Sixteen hundred and eighty-three miles of street-cleaning was done in Chicago during the year 1880, distributed as follows: In the South Division, 934 miles; West Division, 460 miles; North Division, 289 miles. The cost per mile for this work was $26.50. Two hundred and seventy-one street catch-basins and 554 man-holes were constructed in Chicago during the past year. Nearly fifteen miles of sewerage were built in Chicago during the year 1880, at a cost of $175,525.94.

The lowest bidders for paving streets in Chicago are as follows: J. G. McBean, paving with cedar blocks, Clybourn, from North to Racine avenues, $1.94½ a yard; West Lake, from Canal to Halsted street, same party, same pavement, $1.24; West Lake, from Halsted street to Ashland avenue, same party, same pavement, $1.20. Clybourn, from Racine to Fullerton avenue, De Golyer & Co., for plank-curbing, 34 cents a lineal foot, 37 cents a cubic yard for filling, and

$1.40 for paving; Eighteenth street, from Indiana to Calumet avenue, same contractors, curbing 75 cents, and $2.75 a lineal foot for paving to the center of the street, or $5.50 a lineal foot for the full width of forty feet, from curb to curb. The next highest bid to this was 87 cents for curbing, and $9.25 for the paving. Calumet avenue, from Eighteenth to Twentieth streets. De Golyer & Co., curbing, 70 cents, and macadam pavement $2.75 a lineal foot to midway in the street. To these parties the contracts will be awarded, as they are the lowest bidders.

STREET PAVEMENTS.—Commissioner Waller, of Chicago, in his last report thus speaks on the subject of Chicago pavements:

In my last annual report, and in several subsequent communications to the City Council, I have advocated the substitution of stone for wood in street paving—granite blocks on streets of heavy traffic, and macadam topped with granite on other important streets leading to the heart of the city. Surely the wretched condition of our streets to-day furnishes an unanswerable argument against continuing the system of wooden blocks. Millions of dollars have been expended in paving the city, and yet we are but little nearer the goal of well paved streets now than at the commencement. A few of the latest paved streets with wooden blocks are temporarily good, but these must all be removed under a permanent system. With 651 miles of streets now, and the city rapidly growing, what possible hope can we have, under the present system of short-lived wooden pavements, ever to see the streets of our city well and universally paved? We can only pave a comparatively small portion each year. If we were to attempt to do the whole in a few years the sudden and enormous cost would be almost equal to a complete confiscation of the real estate of the city. It is clear that we must do this work by degrees, as we can afford to do it. Now, if we use such material as will speedily decay, and will necessitate being done over again every few years, can we ever hope to get through or to see our streets in much better condition than they are at present. There is no other way, in my opinion, but to advance steadily from year to year toward the accomplishment of a completely paved city by using imperishable material, and doing the work thoroughly and permanently as we progress. It will take many years of continuous, persistent effort to pave the city properly, and the sooner we adopt the only system which will hold together and remain intact until the whole be accomplished the sooner will we reach the desired end. The day for laying plank-roads and using temporary expedients in the heart of the city has passed; let us do thorough work hereafter, commencing in the center and radiating in time to the extreme limits on every side. We want good foundations for our streets to begin with, thoroughly built, put there to stay; if imperishable material only shall be used, as there is no wear upon the substructure, being properly done at first, it need never be replaced. Our best limestone laid carefully and compacted properly is all that we need for this. A topping of ordinary macadam, covered with good gravel free from loam, will answer for most streets outside of the central districts; the road-bed will thus be properly prepared and ready for a better covering hereafter. On the principal streets leading to the heart of the city, and on residence streets where there is much driving, the same foundation will answer. Covered to within four inches of the top with good macadam, and then topping with granite macadam, and filling the interstices of the first layers with good gravel, free from loam, wet down as laid, and thoroughly rolled and compacted, and also filling the interstices of the four inches of granite macadam on top with crushed granite, wet down and rolled, presenting a firm and durable surface, like facing an edged tool with steel to prevent rapid wear, and thus avoiding the dust and mud of an ordinary turnpike topped only with limestone. A street thus paved and carefully looked after and kept up by prompt and timely repairs with the same material, need never wear out, but will grow firmer, and better, and smoother by age. The annual repairs upon such a street would be very light, if promptly attended to, simply filling in with crushed granite or macadam granite, as might be needed, whenever a place on the street begins to wear into a hole or the slightest unevenness. Such pavements, and such a system of prompt attention to them, would give us the prettiest driving streets in the world, smooth as a floor, permanently firm, and comparatively noiseless. A system of watchful and continuous repairs, and the whole expense attending it may be easily provided for by a light annual special tax upon vehicles. To have good streets and pay a light special tax for the comfort and convenience in using them would be a genuine economy and saving to the owners of horses and vehicles in the city. When they reflect upon the injury done to horses and the breaking and repairs to vehicles caused by bad streets, such as they have been compelled to drive over during the past winter, I am sure that all would gladly pay this light tax to have the advantage of the individual benefits and savings which it would bring to each.

It is hardly necessary to mention the importance of forbidding the use of narrow tires with such vehicles as carry heavy loads upon our streets. The sentiment seem to be universal that this is a much-needed reform, and should be speedily inaugurated by the City Council.

As to the comparative expense between durable stone pavements and seemingly cheap wooden substitutes, apart from all other considerations (some of which I have named in this paper), in the long run the permanent pavement is not only unquestionably the cheapest, but a great deal cheaper than any sort or class of temporary expedients.

BRIDGES.

The Wrought Iron Bridge Company of Canton, O., has been awarded a contract for the construction of two swing bridges over the Ohio Canal, one at Port Washington and the other at Newcomerstown, O. The price of the bridges is $2,550 each. The contract was awarded this company over a number of competing bidders.

The total loss of property by the floods on the Missouri River and its tributaries, between Sioux City and Bismarck, is estimated at $2,500,000. Below Sioux City, including the damage done at Omaha, Council Bluffs, Kansas City and the great overflows on both sides of the Missouri between those cities and St. Louis, the amount of loss is computed at $1,500,000.

The aspect of the Rhine at Cologne is likely to be somewhat changed before long, and the hand of civilization will no doubt once again be charged with blotting out another landmark of the past. Two bridges cross the Rhine at Cologne; the one is fixed and constructed of iron, and has since 1860, connected the two banks of the river between Cologne and the small town of Deutz, situated on its right bank. Its length is 430 meters, and its width 22 meters. It serves both for a railway and for horse and foot traffic. The other is a bridge of boats. For some years the question as to the advisability of making this latter a fixed bridge has been discussed with interest by the inhabitants of the old Rhenish city. It has been decided to erect a suspension bridge after an American plan, and the work has been intrusted to the engineer Rendel. As the bridge of boats is each day crossed by about 13,000 persons, the scheme has not, it would appear, been started too soon, particularly if it be borne in mind that, when navigation is very active, this bridge remains open more than twenty times a day for the passage of ships, thus impeding the traffic for nearly five hours.—*The Architect.*

On the 3d the work on the bridge which is to be built across the East River from the foot of Seventy-first street, New York, to Ravenswood, L. I., was begun. The bridge will have an entire length of 2,052 feet, and will be supported by four piers—one on the New York side, two on Blackwell's Island and one at Ravenswood. The piers will be built on bed rock. The first span from New York to Blackwell's Island will be 734 feet; the second, across the island, 700 feet, and the third, to Ravenswood, 618. The height of the piers will be 180 feet each. Dr. Thomas Rainey, ex-President of the New York & Long Island Bridge Company, has charge of the finances of the company, and Mr. Charles A. Trowbridge, the President, will be associated with Messrs. Clark, Reeves & Co., of Phœnixville, Pa., builders of the Second Avenue Elevated Railroad, in the contract for building the bridge. It is proposed to have two tracks for rapid-transit trains, and it is intended to make the time between Ravenswood and the City Hall 20 minutes. The rapid-transit trains will connect with the elevated roads on the New York side, and with the main line of the Long Island Railroad on the Long Island side. Elevators will be placed at each of the piers to carry passengers up to the bridge.

RAILROADS.

WINNIPEG, Man., May 3.—The syndicate officials have assumed the management of the Canadian Pacific Railway. All the late officers and employés have been retained in the service.

A new line is projected from Bellevue, O., west of Watsons Station, on the Cleveland, Sandusky & Columbus Railroad, five or six miles northeast of Tiffin, and a corps of surveyors on the 2d began to lay it out.

An engineer's corps started on the 2d to permanently locate the Des Moines and Kansas City Railway. The right-of-way agent goes with them to secure the way. Elections to vote tax aid by townships are being called. The money is ready to build the road when located.

MANSFIELD, O., May 3.—The Pittsburgh, Ft. Wayne & Chicago Railroad have a corps of engineers between here and Crestline, making a survey for a new road-bed alongside of the main road, to extend from here to Crestline, making a double track, on account of the immense amount of freight being transferred at this point.

NEW LONDON, O., May 3.—A party of Continental Railway surveyors, in charge of Thomas Larkin, of New York, who have made their headquarters here for a week past, have just completed the survey of a line from near Tiffin through this place to the Lorain County line. Contracts for building portions of this road have been let, the construction of the Western Division having been awarded Wm. H. Smith, of Chicago.

FOR RAILWAY MEN.—A new and valuable invention, called Starrat's Spring-keyed Elastic Railroad Frog, has been shown to us, the merits of which are highly spoken of from different roads where it has been used in the Dominion. Any railroad company desirous of obtaining a cheap, elastic and most durable frog, should communicate at once and obtain terms of sale of United States patent, from F. G. Smith, Truro, Nova Scotia.

HARRISBURG, May 4.—A charter was granted at the State Department yesterday to the Conoquenessing Valley Railroad, fourteen miles in length, with a capital stock of $500,000. The road is to run from Butler, where it will connect with the West Penn Railroad, to some convenient connecting point on the Shenango & Allegheny Railroad. The line will lessen materially the distance for transportation of bituminous coal from the Mercer district. J. T. Blair, of Greenville, is President of the road.

OTTAWA, April 28.—The new route for the Pacific Railroad via the Howse Pass, is said to be approximately as follows: From the summit, which is reached by an easy grade, up to Saskatchewan, down to Blackberry River to the Columbia in a southwesterly direction, 40 miles; thence following the right bank of the Columbia River in a northwesterly direction to the Boat-Encampment, 75 miles; thence in a northwesterly direction 90 miles to the Big Eddy; thence westward through Eagle Pass, 45 miles to Shuswap Lake. This is a pretty zigzag course, the great difficulty of which is the crossing of the Columbia River. The engineers tried to avoid the Big Bend of the Columbia River by seeking to cross the Selkirk range of mountains, but were unsuccessful in their attempt to discover a practical route through it.

MEXICO, April 29.—It is understood here to-day that the Mexican Government has sold to an American company its interest in the railway from Vera Cruz to the capital.

The Mexican Railway from Vera Cruz to the capital is administered by the Mexican Railway Company incorporated in England under the Limited Liabilities act in 1862. The road was begun under concessions to Don Manuel Escandon and his associates, in 1857 and 1861, and by the eighth clause of the articles of association 4 per cent. of the net profits of the company are secured in perpetuity to Mr. Escandon and his assigns in each year after the payment of a dividend of 8 per cent. to the shareholders. Mr. Escandon is no longer living, but his heirs are represented on the direction of the company by William Barron, Esq. The authorized capital of the company on the 31st December, 1877, was as follows:

Shares	£6,266,060
Bonds and loans	4,184,069
Total	£10,450,129

Of this amount had been received and expended £8,080,594, or in round numbers $40,000,000. The length of the road operated is:

	Miles.
Main line	293
Jalapa line	70¼
Total	363¼

The gross receipts and expenses were as follows:

	Receipts.	Expenses.	Balance.
Main line	£305,480	£151,591	£153,880
Jalapa line	7,851	7,331	520

The Government interest in this railway, reported as sold in our dispatches to-day, appears in all the statements of the company in the following form:

£800,000 "Inalienable shares," being 40,000 of £20 (or $100 each), representing the Government "subscriptions, and untransferable in perpetuity." How the transfer of these "untransferable" shares can have been effected, remains to be seen. It will be observed, however, that the lines of the company are working at a profit, though the lines were constructed at an expense of more than $100,000 a mile.

RIVERS AND HARBORS.

MUSKEGON, Mich., April 28.—High water has carried away all of the Muskegon Booming Company's dams on White River. The damage done is considerable.

Two new light-houses are to be built on Lake Superior, one on Passage Island, near the upper end of Isle Royale, the other on Sand Island, one of the Apostle group.

NEW ORLEANS, April 28.—The Louisiana Sectional Dry-Dock, belonging to Brady & McLellan, a portion of which sank Monday, has all gone down in thirty feet of water, and is given up as lost. Value, $80 000.

The Board of United States Engineers have adopted Colonel Houston's plans for a harbor of refuge at Milwaukee, with a few slight modifications. It is thought that the $100,000 already appropriated for the construction of the breakwater will be nearly sufficient to finish the north section, 3,000 feet in length.

DES MOINES, Ia., April 30.—The following delegates were appointed by Gov. Gear to attend the convention for the improvement of the Illinois and Mississippi rivers at Davenport May 25: William Tackaberry, of Sioux City; the Hon. Horace Everett, of Council Bluffs; the Hon. R. C. Webb, of Des Moines; the Hon. William Bell, of Burlington; the Hon. John N. Irwin, of Keokuk; the Hon. Ed. H. Thayer, of Clinton; Dr. P. W. McClelland, of Cedar Rapids; the Hon. J. H. Merrill, of Ottumwa; J. F. Bassett, of McGregor; the Hon. John H. Leavitt, of Waterloo. All are prominent business men of the State.

A dismal tale comes from Aspinwall of the state of society and public order in that city. The beginning of work on the Panama Canal has attracted thither shoals of adventurers in quest of employment, or, in too many cases, plunder. As yet there is no work to be done, and the throngs of idlers, without the means of subsistence, are easily led into vice and crime. The half-dozen or less policemen, overworked and underpaid, are unable to maintain order, the jail is crowded to repletion, and the police justice says there is no use sending any more criminals to it, for they do not look upon imprisonment as a punishment, but rather as a cheap way of getting food and lodging.—*N. Y. Tribune.*

WASHINGTON, D. C., April 30.—John M. Wilson, United States Consul at Panama, who is here, speaking of the De Lesseps canal scheme, says: "It is making very little progress. There are about forty Frenchmen down there, half of whom appear to be running lines in various directions, while the other half are Commissaires, and so on. There are, besides, about a hundred Jamaica negroes engaged in cutting brush. Wyse has

returned to France. Nothing like serious work has yet been attempted—none whatever. Six stations have been established on the proposed line across the Isthmus, but no houses have been built, and the men are living in tents. The rainy season has begun, and the men will soon be driven out of their tents by the storms. The truth is, it does not look to me as though De Lesseps ever intends to dig a canal there. He estimates that it will cost $90,000,000, when everybody else who knows anything about such matters says it will cost nearer ten times that sum. He says that the canal will be finished in ten years, and that, in the meantime, the people who buy stock shall receive 5 per cent. interest upon its par value. Thus interest alone will add from 5 to 14 per cent. to the cost of the canal. But I don't believe any canal will be built there. De Lesseps is a great diplomat, but a poor financier, and if he really intends, in good faith, to dig a canal, I think he will fail."

NEW PROJECTS.

The Texas Western Railway Company has filed articles of incorporation. The road will run from San Antonio to Houston and Sabine Pass.

CARROLLTON, O., April 29.—On Thursday the Connotton authorities commenced a survey from Sherradsville to Dennison, where connection will be made with the Pan Handle Railroad

Articles of association of the Louisville, New Albany & Corydon Railroad have been filed. The capital stock is $100,000, and the directors are: Bennett H. Young, St. John Boyle, Charles Goodshaw, George Lyman, S. M. Stockslager, Thomas McGrain and Samuel J. Wright.

The Chicago, Decorah & Minnesota Railroad Company has been organized, with a capital of $15,000,000, to build a road from Decorah, in Winneshiek County, to some point in Minnesota, but first to connect with the Burlington, Cedar Rapids & Northern at Postville.

The Shenandoah Valley Railroad Company announces the completion of its extension from Hagerstown, Md., to Waynesboro, Va. Another extension, from Waynesboro to a connection with the Norfolk & Western Railroad, is now in the course of construction, and will be completed during the present year.

A special dispatch from Austin says that the Austin & Northwestern Railroad Company filed its charter in the office of the Secretary of State on Friday, the 29th ult. The road is to run from Austin through the counties of Travis, Williamson, Burnet, Lampasas, San Saba, McCulloch, Coleman, Runnels and Taylor, with a branch to Rio Grande.

Meriden, Conn., manufacturers held a meeting Saturday last, to discuss the building of a narrow-gauge freight railroad to New Haven, 18 miles, and it was estimated that it could be built for $10,000 a mile. Several companies pay very large amounts to the Consolidated road for freights, and think it would pay them better to have a road of their own.

The incorporation articles of the Boulder, Middle Park & Green River Railway Company have been filed with the Secretary of State of Colorado. The stock of the company is capitalized at $1,000,000, divided into 20,000 shares of $50 each. The incorporators are Levi Chenny, Richard Crow, Chas. Dabney, Samuel Hellner, A. J. Mackey, Hiram E. Washburn and Eben Smith.—*Denver Republican.*

Articles of incorporation have been filed in California by the Santa Rosa & Sonoma Railroad Company for the purpose of constructing a broad-gauge road from Santa Rosa, through the Sonoma Valley to Benicia, a line of fifty miles. Principal place of business, Santa Rosa; directors, W. S. M. Wright, James B. Rue, E. T. Farmar, A. A. Bean, David Burris, F. G. Hahman and George P. Noonon, of Santa Rosa. Capital stock, $1,000,000, divided into 10,000 shares.

It is reported at Milwaukee that the Chicago, Milwaukee & St. Paul Company will shortly contract a line from McFarland, a station about seven miles east from Madison, on the company's Prairie du Chien division, to Genesee, intending to make it an air-line from Madison to Milwaukee. To do this it would be necessary to build about forty miles of road. The line, if constructed, will pass through a fine country, running four or five miles south of the Northwestern's line.

SPRINGFIELD, Ill., April 29.—The Secretary of State to-day licensed T. S. Sprague, of Detroit; A. Dowen, of Plainfield, Ind.; J. W. Spray, of Jefferson, Ill.; R. S. Mallory and Wm. B. Thompson, of Chicago, to organize a Trans-Continental Railroad of Illinois, with a capital of $1,680,000. The object is to build a railroad from a point on the Wabash River in Crawford County, Ill., through Crawford, Jasper, Effingham, Fayette, Bond, Madison and St. Clair counties, to or near the city of East St. Louis.

A Montreal dispatch says: "Railway magnates belonging to this Province and Ontario have been in conference here taking steps for the formation of a new company for running an air-line in connection with the Quebec, Montreal & Ottawa Railway from the Dominion capital to Toronto, so as to make another through line to the West jointly with the Great Western of Canada, in opposition to the Grand Trunk. It was finally agreed to organize the company with $1,000,000 capital, a large proportion being accepted by the various railway companies interested in the project, and the rest was taken by those present at the meeting. The following railways were represented at the conference by their presidents: Great Western, Credit Valley, Canada Central, Southeastern & Quebec, Montreal & Ottawa. Hon. Adam Braur, of Hamilton, Chairman of the Great Western, was elected President, and the following gentlemen directors: Hons. Chapleau, Premier of Quebec; L. R. Church, M. P. for Thibeaudeau; Messrs. Duncan McIntyre, Director Canada Pacific; A. B. Chaffee, Vice-President Southeastern, Howland, Campbell, Gordon, Osler and Bickford. Engineer-in-Chief Lumsden, who has made a partial survey of the line, was present, and was directed to complete his work, so that operations might be commenced at once. A charter has already been granted.

CONTRACTING, MISCELLANEOUS, ETC.

Taunton, Mass., has voted $30,000 for a city hall site.

The contract for paving Main street, in Peoria, Ill., has been awarded to Patrick Kelly for $25,219.

J. and P. Lyons, and Thomas Dunn have secured the contract for erecting the Parliament buildings at Winnipeg.

Waupaca City has voted $5,000 toward the erection by the county of a $15,000 court-house. Work will commence immediately.

The Hallowell Granite Company has recived a $20,000 contract to furnish granite for the extension of the New York *Tribune* building.

OTTAWA, Ont., April 30.—The contract for Indian supplies in the Northwest has been awarded to J. G. Baker & Co., of St. Louis.

Dover and Foxcroft, Me., propose to join hands in building a common town hall, and $8,000 of the necessary $12,000 has been subscribed.

Nearly a thousand men are at work on the Pittsburgh, New Castle & Lake Erie Railroad, and its building is progressing with wonderful rapidity.

DES MOINES, Iowa, April 30.—There is a great scarcity here of stone masons, bricklayers, carpenters, and wood-workers. Builders are unable to go ahead in consequence.

The Department of Public Works, Chicago, saved to the city over $3,000 by readvertising for the street cleaning. The contracts let on the 30th ult. aggregated $10,186.99.

About 1,000 men are at work on the Council Bluffs Extension of the Chicago, Milwaukee & St. Paul Railway near Cedar Rapids, Ia., and large numbers of hands are arriving daily.

It is rumored that the Canada Pacific Railway Company will build extensive car works in Brookville, Ont., provided the corporation give them land on which to build the said works.

The contracts for the construction of the first forty miles of the New Albany & St. Louis Railroad, west of New Albany, Ind., and ten miles west from Albion, Ill., have been awarded.

Four engineering parties have started out from Winnipeg to explore the mountain passes for the Canada Pacific Railway. Similar expeditions have been dispatched eastward from Victoria, B. C.

The Sewer Committee of North Adams, Mass., met a few evenings since to discuss the question of beginning work on the new sewer. It is reported that a man is ready to build it for less than the $17,000 appropriation.

Sherman, Flagler & McDonough, of West Troy, N. Y., have a contract with the New York, Wisconsin & Western Railroad, amounting to about $350,000. The work is located near Haverstraw, N. Y. Ground will be broken in a few days.

William A. Chuff has been awarded the contract for paving Market street, Philadelphia, from Merrick street to Thirtieth street with Belgian blocks, the price being $145 per square yard, the total being 27,733 square yards at $40,212.

Edison's business man says he has on file applications from more than three thousand cities and villages in which electric light companies are to be formed. The price of gas stock is not appreciating nor are there many more companies being organized.

Work on the Newcastle & Rushville road has been commenced on both ends of the line. The Fort Wayne, Muncie & Cincinnati people are pushing the enterprise. This is the road for which the equipments were bought before the line was surveyed.

The Continental Works, Greenpoint, L. I., have commenced the construction of four large beam engines, having the Twiss cut-off. Mr. Thomas F. Rowland hopes to demonstrate that this engine will be equal, if not superior, in duty to the best automatic cut-off engines.

Messrs. Oviatt, contractors for that part of the Philadelphia & Long Branch Railroad between Whiting's and Point Pleasant, have completed grading. The long bridge across Barnegat Bay is about two-thirds done. Three steam pile-drivers are kept running. The laying of the ties and steel rails from the Whitings terminus has begun. The road is to be opened about the 15th of June.

Sealed proposals will be received at the office of the Light-house Board, 532 Walnut street, Philadelphia, until the 19th inst., for taking down the frame buoy and supply shed (142 feet by 50 feet), at the mouth of the Christiana River, Delaware; transporting the same to the wharf at the Front Beacon, Cherry Island Flats Range, Delaware, and erecting it in as good a condition as it now stands.

The machine works of J. S. Mundy, formerly on Railway avenue, Newark, N. J., are now located with more extensive capacity on Prospect street, in the same city. The specialties are hoisting engines, steam engines, mining machinery, etc. The shop is crammed full of work. There are nine hoisting engines ordered, besides a powerful engine for Norfolk, Va., and a clam-shell mud dredging machine.

The New Albany *Ledger* says: D. J. Conger, contractor for the first four sections of the Louisville, New Albany & St. Louis Air-Line road west from that city, will commence work on his contract on Wednesday next, May 4. Within a week all the contractors will be at work, and by the 20th of August the company expect to have the cars running between New Albany and Milltown, Crawford County.

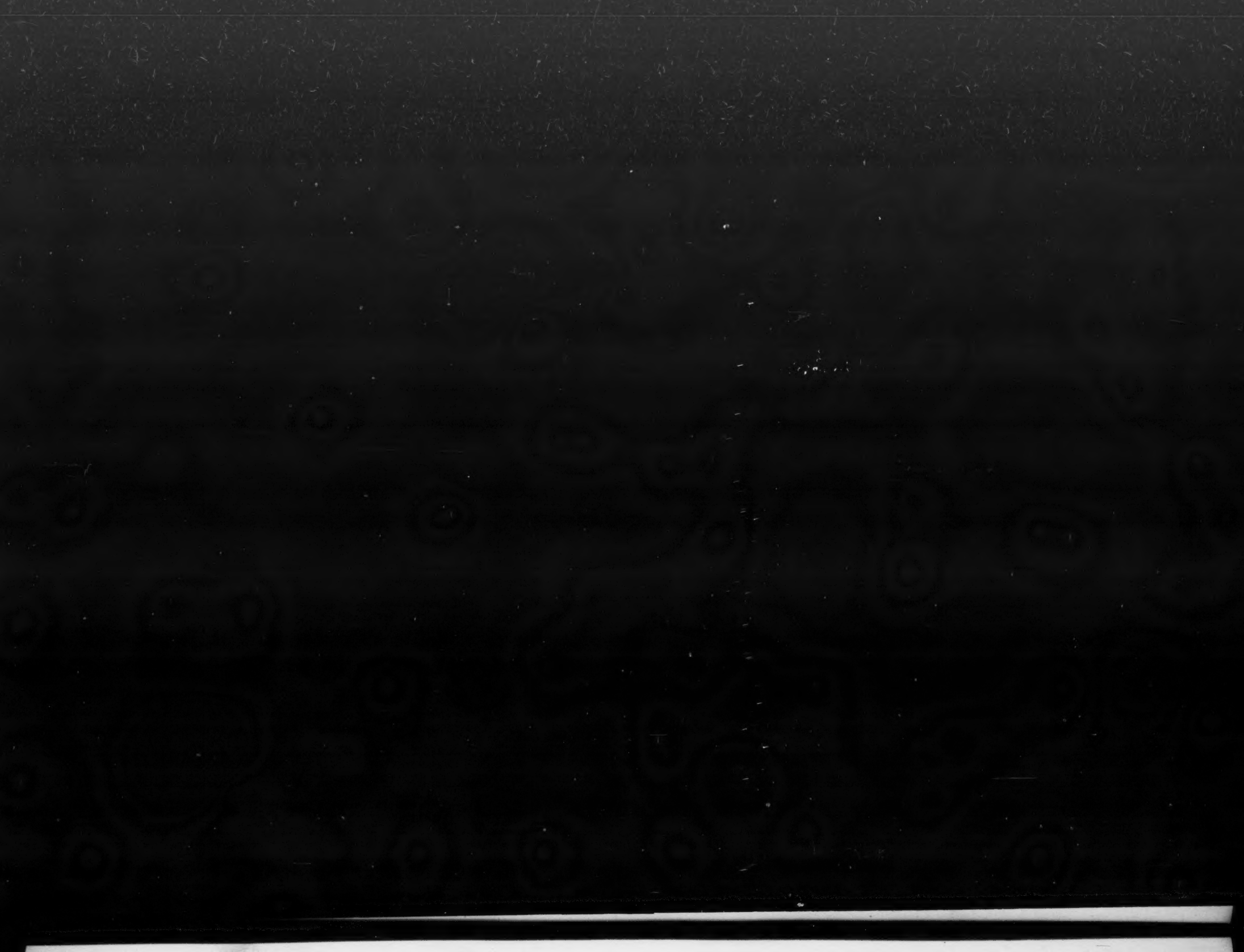
PAINESVILLE, May 1.—General J. S. Casement informed a reporter this morning that they (the Casement Bros.) had sub-let their contract from Cleveland to Erie, and that work will be commenced this week on every section of it. Large forces of men will be put on and the work prosecuted vigorously to completion. The permanent location of the line through our corporation is not definitely settled.

The cost of material and labor has so far advanced as to make a marked difference to railroads ordering new rolling-stock. Locomotives have advanced from $9,000 to $11,500. The increase in the price of passenger coaches has been about one-third, they being now quoted at about $4,500. Freight cars have advanced in about the same ratio from $450 to $625 each. One of the leading roads of the country has recently ordered 3,000 at $650 each.

It may not be generally known that the Howard Hydraulic Cement Works at Cement, Barrow County, 1½ miles north of Kingston on the W. & A. Railroad, are the only works of the kind south of Louisville, Ky. These works have lately doubled their capacity for manufacturing, and have shipped at this date twice as much as last spring. This cement is equal to any and inferior to no natural cement in America. It is similar to English Portland. Mr. George H. Waring is proprietor of the above works.

New England capital is developing the resources of the prolific State of Florida. The Florida & Southern Railway Company, which connects Palatka, on the St. John's River, with Gainsville, and west to Lake City and south to Tampa Bay, will open up the entire State. It is a narrow-gauge railroad, and when completed will consist of 390 miles of road. It is expected that the first division between Palatka and Gainsville will be opened during the month of June. Mr. Johnathan Dwight, who built the Toledo & Delphos road and the extension of the New York & New England, is superintending the construction.

Collector Howe and Architect Scofield Monday morning, the 2nd inst., opened proposals for the masonry and iron-work of the additions to the Cleveland post-office building, and recommended the following awards: Cleveland Bridge and Car-works, iron work, at $25,946; Thomas H. Linus, masonry, at $92,300. The above proposals will be forwarded to the supervising architect at Washington for approval. Work upon the walls will probably be commenced within ten days. Proposals for carpentering, plastering, roofing, stairways, etc., will be advertised for as work upon the building progresses.

A company known as the Hudson Tunnel Silt Company has brought a suit against Dewitt C. Haskins, formerly President of the Hudson River Tunnel and Railroad Company, to recover $100,000 damages. The plaintiff alleges that defendant, assuming to act for his company, made an agreement to give plaintiff all the silt to be taken out of the tunnel for the removal, and to take in turn and pay for all the bricks made from it which might be needed, if of a specified quality. The defendant's company repudiated the contract and the defendant's authority to make it, and now the plaintiff seeks to hold him personally responsible. A motion was made in Supreme Court, Chambers, before Judge Donohue, on the 5th, on the part of the defendant, to have portions of the complaint stricken out, and the judge reserved his decision.

Under the head of "miscellaneous data" Commissioner Waller says: "Chicago covers an area of nearly thirty-six square miles, or 23,040 acres. There are 789 acres in public parks, 385 acres in the river, its branches, the slips and the Illinois & Michigan Canal. The streets of the city measure 651 miles, are known by 907 names, and cover 5,200 acres. About 153 miles of the streets are paved (principally with wooden blocks). There are 756 miles of sidewalks, 337 miles of public sewers, and 459⅓ miles of water-pipes (mains). There are about twenty-nine miles of river frontage (counting both sides), and twelve miles of slips and basins, making forty-one miles of water frontage in the inner harbor. There are thirty-two bridges in the city, that cost an average of about $25,000 each, and eighteen viaducts, ranging in cost from $60,000 to $230,000 each. In conclusion, I can only repeat what I distinctly stated in my last annual report, and what another year's experience has only the more thoroughly convinced me of, that the Department of Public Works, if managed in the most successful manner for the best interests of the whole city, should be conducted on purely business principles. It is eminently a working department, having nothing whatever to do with politics, or the intrigues of political parties. Its employés, therefore, should be selected for their qualifications and fitness for the place which they are expected to fill, and with an eye single to the public good; earnest, competent, faithful men, who will take a pride in doing their whole duty, and who will protect such interests of the city as are confided to them with precisely the same care as they would their own. Not a man more than the city actually needs should ever be employed, and none should be retained that are incompetent, insubordinate, unfaithful, intemperate, or from any other cause unprofitable to the city. I hold these views honestly and firmly."